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February 21, 1992

ATKEARNEY

Ms. Rowena Sheffield
Regional Project Officer
U.S. Environmental Protection Agency
345 Courtland Street NE
Atlanta, Georgia 30365

Reference: EPA Contract No. 68-W9-0040; Work Assignment No. R04-19-14; Occidental Chemical; Muscle Shoals, Alabama; EPA I.D. No. ALD004019642; RCRA Facility Assessment; Final Deliverable

Dear Ms. Sheffield:

Enclosed please find the RCRA Facility Assessment (RFA) for the above-referenced facility. This report presents the results of the Preliminary Review (PR) and the Visual Site Inspection (VSI). The RFA resulted in the identification of 25 Solid Waste Management Units (SWMUs) and 4 Areas of Concern (AOCs).

The Occidental Chemical Corporation (OxyChem) facility in Muscle Shoals, Alabama is a chlor-alkali plant that currently produces chlorine, potassium hydroxide, potassium carbonate, and hydrogen gas. For several decades and until 1991, the facility also produced sodium hydroxide.

Extensive groundwater and soil contamination has been documented beneath the facility. Principal constituents detected include chlorides, mercury, and cadmium. Groundwater beneath the site occurs in an Upper Zone, a Lower Zone and a Deep Zone. Groundwater assessment studies have characterized the mercury and chloride plumes as originating in the vicinity of the Landfill (SWMU 1), the Former South and North Impounding Basins (SWMUs 2 and 3), the Former Salt Storage Piles (SWMU 4), the Mercury Cell Room Trench System (SWMU 7), process units outside the cell building, the Industrial Sewer System (SWMU 14), the Old East Outfall Ditch (SWMU 15), the Southern Stormwater Discharge Ditch (SWMU 23), and the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24).

OxyChem is currently under an Administrative Order and compliance schedule to complete additional groundwater assessment and implement corrective action. Based on an agreement between Region IV EPA and OxyChem, confirmatory sampling will not be conducted as part of the RFA. Instead, conclusions reached during the RFA will be incorporated into the RCRA Facility Investigation (RFI). Consequently, only two courses of action were considered for recommendation in this RFA: a RFI or no further action. The units listed below have been designated for participation in the RFI:

- Landfill (SWMU 1)
- Former South Impounding Basin (SWMU 2)
- Former North Impounding Basin (SWMU 3)
- Salt Storage Piles (SWMU 4)
- Sludge Pads (SWMU 6)
- Mercury Cell Room Trench System (SWMU 7)
- Former Hypalon-Lined Storage Tank Location (SWMU 8)
- Mercury Collection Vessel (SWMU 10)
- Scrubber Solution Treatment Tank (SWMU 13)
- Industrial Sewer System (SWMU 14)
- Old East Outfall Ditch (SWMU 15)
- Southern Stormwater Discharge Ditch (SWMU 23)
- Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
- Waste Pile Storage Areas (SWMU 25)
- Junkyard (AOC A)
- Old TVA Pipeline Right-of-Way (AOC B)
- Gravel Covered Area Adjacent to Electric Substation (AOC C)
- Old East Ditch (AOC D)

No further action is suggested for the remaining units, provided the facility remains in compliance with the applicable permits. As an interim measure, it is suggested that the facility immediagely discontinue the practice of releasing wastewater from the Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14). There should also be an evaluation of an offsite area (Pond Creek) because it has historically received wastewaters with high mercury concentrations from the facility. Refer to the Executive Summary Table for a synopsis of the facility SWMUs and AOCs.

Per EPA's request, this deliverable has been double-sided and reproduced on recycled paper. Please contact me if you have any questions concerning this report.

Sincerely,

A. Denise Turner

A. Denise Turner, Ph.D.
Technical Director

Enclosure

cc: P. Anderson, EPA Region IV
G. Hardy, ADEM
W. Jordan
L. Poe
D. Scott
D. Anderson, KWBES
L. Potts, Baker

DOCKET NO. 110

A004019642
ENI

RCRA FACILITY ASSESSMENT

OF

OCCIDENTAL CHEMICAL CORPORATION
MUSCLE SHOALS, ALABAMA

EPA I.D. NO. ALD004019642

SUBMITTED BY:

BROWN ENVIRONMENTAL SERVICES
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COLLEGE STATION, TEXAS 77845

SUBMITTED TO:

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1100 ABERNATHY ROAD
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FOR SUBMISSION TO:

MS. ROWENA SHEFFIELD
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ATLANTA, GEORGIA 30365

IN RESPONSE TO:

EPA CONTRACT NO. 68-W9-0040
WORK ASSIGNMENT NO. R04-19-14

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DOCKET NO. 110

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I. EXECUTIVE SUMMARY

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) authorized EPA to require corrective action for releases of hazardous wastes and/or hazardous constituents from Solid Waste Management Units (SWMUs) and other Areas of Concern (AOCs) at all operating, closed or closing RCRA facilities. The intention of this authority is to address previously unregulated releases to air, surface water, soil, and groundwater. The first phase of the corrective action program, as established by EPA, is development of a RCRA Facility Assessment (RFA). The RFA includes a Preliminary Review (PR) of all available relevant documents, a Visual Site Inspection (VSI) and, if appropriate, a Sampling Visit (SV). Based on the results of the PR and VSI, waste management operations at Occidental Chemical Corporation (OxyChem) have been described along with various SWMUs and AOCs at the facility. In addition, these investigations have assessed each SWMU or AOC as to its potential for release of hazardous constituents and its need for corrective action.

This RFA is based on a PR of files from EPA Region IV and the Alabama Department of Environmental Management (ADEM), and a VSI. The PR was performed during November 1991, and the VSI was conducted on December 12 and 13, 1991.

The OxyChem plant site is located northeast of Muscle Shoals, Alabama, approximately two miles south of the Tennessee River. Facility property includes a total of 720 acres. The plant site is centered on approximately 80 acres which includes production areas, a golf course, leased-out cotton fields, and undeveloped woodlands. The plant was constructed in 1952 and purchased by OxyChem in 1986. The plant produces chlorine, potassium hydroxide, potassium carbonate and hydrogen gas (Ref. 2).

Current and former operating areas within the plant include the Mercury Cell Room Trench System (SWMU 7), the Former North Impounding Basin (SWMU 3), the Former South Impounding Basin (SWMU 2), Salt Storage Piles (SWMU 4), the Landfill (SWMU 1), the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24), the wastewater treatment plant (SWMUs 19-22) and the Industrial Sewer System (SWMU 14). Improvements in power distribution and mercury cell construction have resulted in the growth of plant capacity from 150 tons of chlorine per day to a current capacity in excess of 400 tons of chlorine per day. In addition, modifications to plant operations appear to have improved the recovery of mercury from process areas.

Chlorine, mercury and cadmium are found to varying degrees in each of the plant's solid waste streams. Solid wastes generated at the OxyChem plant include brine sludges, brine filter, backwash muds, saturator sludges, assorted carbon filter packs/cakes, and industrial wastewater sump sludges. Solid wastes were landfilled onsite until offsite disposal began in February 1980.

Extensive groundwater contamination has been documented beneath the OxyChem facility. Principal constituents detected in soil and groundwater include chlorides, mercury and cadmium. The areas which appear to have been the primary sources of contaminant release to soil and groundwater include the Salt Storage Piles (SWMU 4), the Industrial Sewer System (SWMU 14), former discharge of excess brine to the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24), the Former North Impounding Basin (SWMU 3), the Former South Impounding Basin (SWMU 2), several unlined discharge ditches (SWMUs 15, 16, 23, and AOC D), the Mercury Cell Room Trench System (SWMU 7), and the Landfill (SWMU 1). Other possible sources of contaminant releases include the Gravel Areas Adjacent to Electrical Substation (AOC C) where contaminated stormwater could have seeped into the ground, and the former sites of unenclosed bulk waste management (SWMUs 6 and 25). Close examination of the Gravel Areas Adjacent to Electrical Substation (AOC C) also revealed oily stains beneath the surficial gravel layer.

The extent of elevated chloride levels to the east of the Landfill (SWMU 1) had not been characterized as of 1989. Elevated cadmium concentrations in groundwater are centered on the area south of the Mercury Cell Building. Excess brine, containing mercury and cadmium, has been discharged from facility process areas in a variety of ways, including into a natural low area south of the Mercury Cell Building. Contact wastewaters and contaminated stormwater runoff were in the past discharged to the Industrial Sewer System (SWMU 14), unlined ditches (SWMUs 15, 16, and 23, and AOC D), the Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24), and the unlined Former North and South Impounding Basins (SWMUs 2 and 3).

OxyChem has obtained closure approval from the State of Alabama for the Waste Pile Storage Areas (SWMU 25). In addition, the Alabama Department of Public Health expressed concerns about the plant Landfill (SWMU 1) in 1980. Groundwater sampling between 1988 and 1989 revealed concentrations as high as 93,500 ppm chloride, 340 ppb mercury, and 330 ppb cadmium. Based on these data, the Alabama Department of Environmental Management (ADEM) issued a Notice of Violation to OxyChem. The facility is currently under an ADEM Administrative Order and a compliance schedule to complete additional groundwater assessment and to propose and implement corrective action.

A total of 25 SWMUs and 4 AOCs were identified at the OxyChem Muscle Shoals Plant as a result of the PR and VSI. Refer to Table I-1 for a synopsis of the facility SWMUs and AOCs. The Agency and facility have agreed to eliminate the confirmatory sampling step and proceed directly to the RCRA Facility Investigation (RFI). Consequently, only a RFI or no further action was suggested in this RFA. The units listed below have been designated for participation in the RFI:

- Landfill (SWMU 1)
- Former South Impounding Basin (SWMU 2)
- Former North Impounding Basin (SWMU 3)
- Salt Storage Piles (SWMU 4)
- Sludge Pads (SWMU 6)
- Mercury Cell Room Trench System (SWMU 7)
- Former Hypalon-Lined Storage Tank Location (SWMU 8)
- Mercury Collection Vessel (SWMU 10)
- Scrubber Solution Treatment Tank (SWMU 13)
- Industrial Sewer System (SWMU 14)
- Old East Outfall Ditch (SWMU 15)
- Southern Stormwater Discharge Ditch (SWMU 23)
- Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
- Waste Pile Storage Areas (SWMU 25)
- Junkyard (AOC A)
- Old TVA Pipeline Right-of-Way (AOC B)
- Gravel Areas Adjacent to Electric Substation (AOC C)
- Old East Ditch (AOC D)

No further action is suggested for the remaining units, provided the facility remains in compliance with the applicable permits. An interim measure, it is suggested that the facility immediately discontinue the practice of releasing wastewater from the Mercury Collection Vessel (SWMU 10) to the Industrial Sewer System (SWMU 14).

It is apparent from the facility-wide nature of the contamination, that the entire facility should be considered in the RFI. In some cases, past investigations have documented the existence but not the full extent of contamination. It should be a central premise of the RFI that both the horizontal and lateral extent of contamination will be fully defined. The facility should also remediate the existing contamination and deal effectively with the sources of continuing release(s) to the environment.

An evaluation of an offsite area (Pond Creek) has also been suggested because it has historically received facility wastewaters with high mercury concentrations. Sediment samples should be collected at designated intervals along its length and also in areas of the creek where sediments may accumulate. The purpose of this investigation should be to determine the magnitude and extent of contamination. The sampling should continue along the length of the creek until it is determined that no contaminated sediments were detected at three or more sampling locations.

TABLE I-1.
OCCIDENTAL CHEMICAL CORPORATION
EXECUTIVE SUMMARY TABLE.

SWMU/AOC	Type of unit	Years in operation	Wastes managed[a]	Pollution migration pathways[b]	Evidence of releases	Exposure potential[c]	Recommendation	
							RFI	No further action
1 Landfill	landfill	1955–1980	A, B, C, D, E	A, SW, S, GW, SS	yes	U	X	
2 Former South Impounding Basin	surface impoundment	1970–1976	E	A, SW, S, GW, SS	yes	U	X	
3 Former North Impounding Basin	surface impoundment	1970–1971	E, F, G	SW, S, GW	yes	U	X	
4 Salt Storage Piles	bulk product storage	1953–1991		S, GW	yes	L	X	
5 Brine Filter Backwash Collection Tank	tank	1990–present	A		no	L		X
6 Sludge Pads	waste storage area	1953–present	B	S, GW	no	U	X	
7 Mercury Cell Room Trench System	trenches/sump	1953–present	E	S, GW	yes	U	X	
8 Former Hypalon-Lined Storage Tank Location	tank	1976–1981	E, G		no	L	X	
9 Mercury Retort Tanks	tanks	1988–present	C, D		no	L		X
10 Mercury Collection Vessel	tanks	1988–present	E	S, GW	yes	U	X	
11 Hazardous Waste Roll-Off Pad	storage pad	1985–present	A, C, K, M		no	L		X
12 Emergency Chlorine Scrubber Tanks	tanks	1974–present	I		no	L		X
13 Scrubber Solution Treatment Tanks	tanks	1974–present	J	SW, S	no	L	X	
14 Industrial Sewer System	sewer system	1953–present	E, F, G	A, SW, S, GW, SS	no	U	X	
15 Old East Outfall Ditch	ditch	1953–present	E, F, G, S	SW, S, GW	no	U	X	
16 NPDES Outfall Ditch	ditch	1971–present	E, F, G, S	SW, S, GW	no	L		X
17 Wastewater Treatment Frame Filter Presses	filters	1974–present	A, K		no	L		X
18 Former PCB Storage Area	temporary storage	1980–1987	L		no	L		X
19 500,000-gallon Wastewater Storage Tank	tank	1981–present	E, G		no	L		X
20 Wastewater Treatment Hydrazine Reaction Tank	tank	1974–present	E		no	L		X
21 Wastewater Treatment Carbon Polishing Towers	tank	1974–present	F		no	L		X
22 Carbon Tetrachloride Stripper	tank	1956–present	N		no	L		X
23 Southern Stormwater Discharge Ditch	ditch	unknown–present	G, P	SW, S, GW	yes	U	X	
24 Stressed Vegetation Area South of Former South Impounding Basin	discharge area	unknown–present	G, P	SW, S, GW	yes	U	X	
25 Waste Pile Storage Areas	waste piles	1980–1984	A, C, D, H, K, M, N, O	S, GW	no	U	X	
A Junkyard	storage area	unknown–present	O	SW, S	no	L	X	
B Old TVA Pipeline Right-of-Way	right-of-way	unknown–present		SW, S	no	L	X	
C Gravel Areas Adjacent to Electrical Substation	surface spill	unknown–present	Q	SW, S, GW	no	L	X	
D Old East Ditch	earthen ditch	unknown	E, F, G, R	SW, S, GW	yes	U	X	

a A = brine sludges (K071); B = saturator precipitates; C = assorted carbon filter packs/cakes; D = industrial wastewater sump sludges; E = untreated wastewaters; F = treated wastewaters; G = stormwater runoff; H = used motor oil; I = sodium hypochlorite; J = treated scrubber solution; K = wastewater treatment sludges (K106); L = PCB-containing oils and debris from SCP spills; M = D009 waste; N = F001 waste; O = used equipment; P = excess brines; Q = unidentified spilled materials; R = leachate seeping from the landfill; S = washwater from tank cars, barge tanks, and chlorine storage tanks.
b GW = groundwater; SW = surface water; S = soil, A = air; SS = subsurface gas.
c L designates a low, M designates a moderate, H designates a high, and U designates an unknown exposure potential; see SWMU description for substantiation.

II. INTRODUCTION

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) authorized EPA to require corrective action for releases of hazardous wastes and/or hazardous constituents from Solid Waste Management Units (SWMUs) and other Areas of Concern (AOCs) at all operating, closed, or closing RCRA facilities. The intention of this authority is to address previously unregulated releases to air, surface water, soil, and groundwater.

The first phase of the corrective action program, as established by EPA, is development of a RCRA Facility Assessment (RFA). The RFA includes a Preliminary Review (PR) of all available relevant documents, a Visual Site Inspection (VSI) and, if appropriate, a Sampling Visit (SV). Based on the results of these investigations, the SWMUs and AOCs at the facility are identified, and each is assessed as to its potential for release of hazardous constituents and its need for corrective action.

This report summarizes the results of the PR conducted during November 1991 and the VSI conducted on December 12 and 13, 1991. A total of 25 SWMUs and 4 AOCs were identified at the site. Chapter II summarizes the results of the file search and the VSI, and provides additional information concerning the history, process descriptions, waste management practices, environment, and demographic setting of the facility. The SWMUs and AOCs are assessed in Chapter III. Tables which are presented in Chapter IV list all units/areas and categorize them according to the further action required. The references used in this report are listed in Chapter V. Appendix A contains the VSI log which was maintained during the site visit, and Appendix B presents the Photographic Log documenting the physical condition of the SWMUs and AOCs at the time of the VSI. Appendix C provides the SWMU location map.

A. Preliminary Review and VSI

This RFA report is based on a review of file material available at EPA and State offices, and on observations made during the VSI. The file review was conducted during November 1991 and included a review of RCRA files available at EPA Region IV and the Alabama Department of Environmental Management (ADEM). The VSI was conducted on December 12 and 13, 1991 by an EPA contractor team (David Anderson and Brian Sullivan of K. W. Brown Environmental Services [KWBES]) and a representative from EPA Region IV (Pat Anderson).

The VSI team arrived at the facility at 8:25 a.m. on December 12, 1991. They met with Occidental Chemical representatives Andy Lampert, Gerald E. Clarke and Chris L. Manley. Also in attendance were Robert Hagood, Dave Davis, and Ayman El-Husari of the Alabama Department of Environmental Management; and Daniel E. Adams, G&E Engineering, Inc. The morning discussions focussed on historical and current facility process operations and waste management practices. The VSI team broke for lunch at 11:50 a.m. and reconvened at 12:40 p.m. to continue discussions.

The site tour began at 2:05 p.m. Weather was heavily overcast with a temperature of approximately 60° Fahrenheit. The VSI team viewed outlying facility structures and outdoor areas of the facility, including facility drainage ditches and outfalls. The site tour was halted for the day at 4:50 p.m.

The VSI team arrived at the facility for the second day of VSI activities at 7:45 a.m. Robert Hagood and Dave Davis, from the Alabama Department of Environmental Management, did not attend the second day of the VSI. There was a brief discussion of the day's tour agenda and the availability of information concerning the most recent cover construction activities at the Landfill (SWMU 1). The site tour was resumed at 9:10 a.m. The weather was overcast and raining, with a temperature of approximately 60° Fahrenheit.

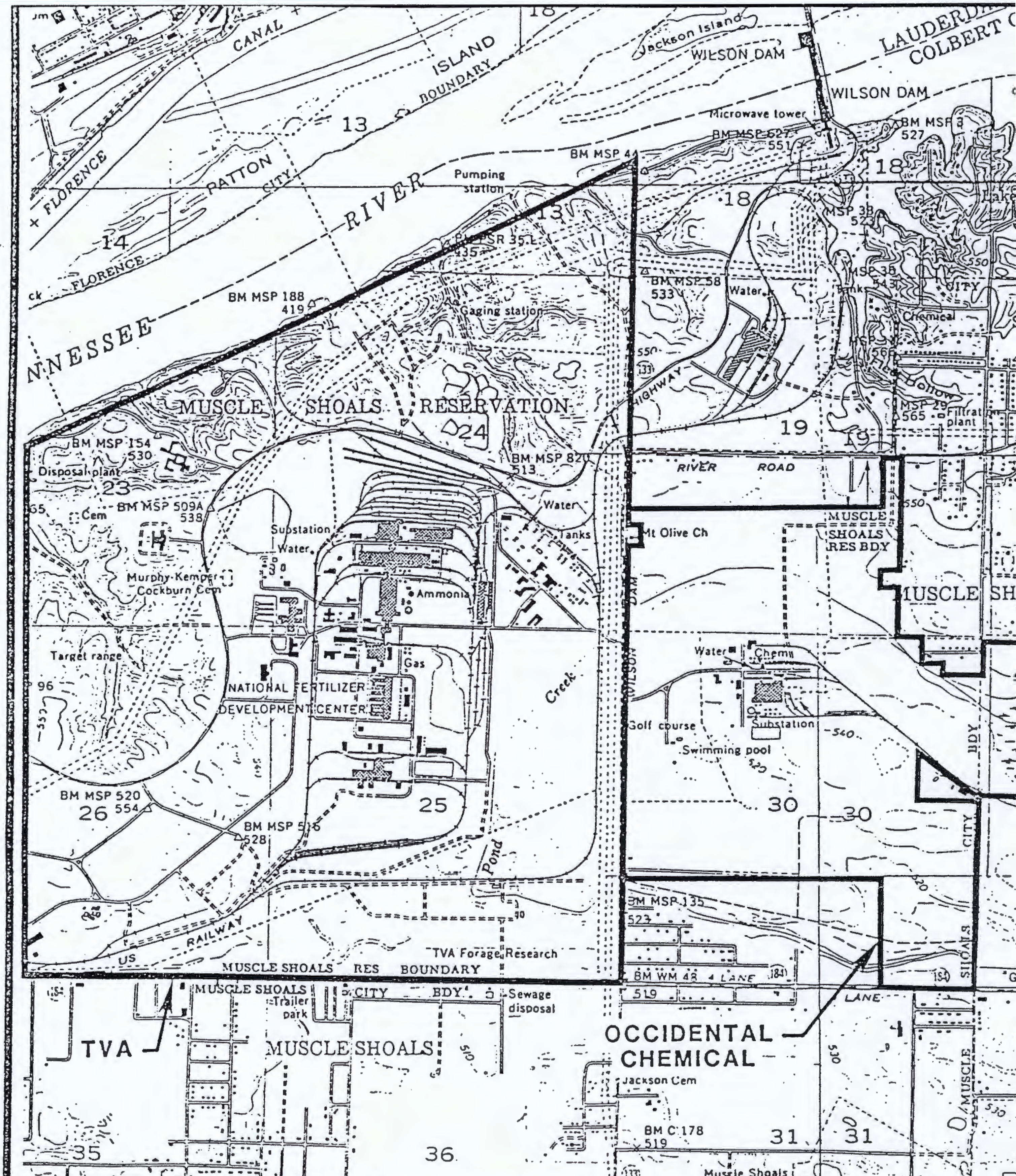
Primary facility production areas and the facility wastewater treatment plant were viewed, and the facility Landfill (SWMU 1) was revisited to observe and characterize water drainage atop the landfill cover under wet conditions. The tour was completed at approximately 11:20 a.m. at which time the VSI team broke for lunch. The VSI team divided after lunch to cover remaining points of interest. Brian Sullivan, Andy Lampert, and Dan Adams inspected a bottomland area located on facility grounds south of the plant and east of the facility golf course and recreation area. David Anderson, Pat Anderson, Ayman El-Husari, and Gerald Clarke conducted a tour of unpaved facility areas by automobile. The VSI team reconvened at 1:20 p.m. to review the list of information needs developed during the VSI to which the facility agreed to respond. The team left the facility at 2:25 p.m.

B. Facility Description

The OxyChem Muscle Shoals plant occupies approximately 720 acres in the town of Muscle Shoals, Colbert County, Alabama. The plant is located approximately two miles south of the Tennessee River and 60 miles west of Huntsville, Alabama (at latitude 37 degrees, 46 minutes and 020 seconds and longitude 087 degrees, 37 minutes, and 040 seconds). A map of the vicinity is presented in Figure II-1. The site includes the manufacturing plant, an inactive hazardous waste landfill located east of the facility, a wetlands area north of the facility (the Former North Impounding Basin, SWMU 3), a golf course and recreation area to the west and southwest of the plant, and bottomland woods, wetlands, and leased agricultural lands located south and east of the plant.

Figure II-1

Vicinity Map



RE: 7.5 MINUTE SERIES QUADRANGLE MAP, FLORENCE, ALABAMA, & KILLEN, ALABAMA 1971.

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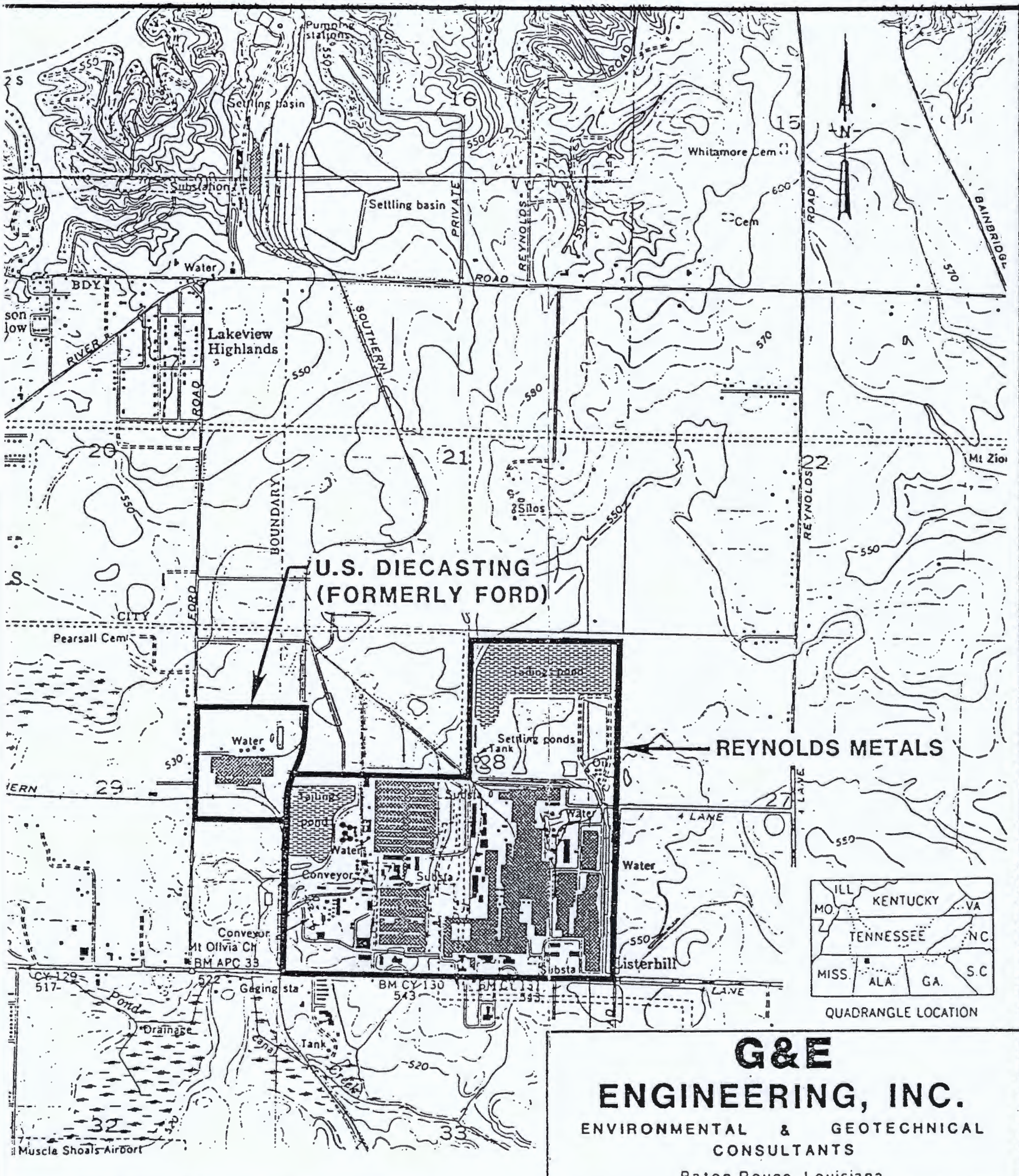


G&E ENGINEERING, INC.

ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

Baton Rouge, Louisiana

GROUNDWATER ASSESSMENT MUSCLE SHOALS FACILITY MUSCLE SHOALS, ALABAMA Project Title	VICINITY MAP	1-1 Fig. No.

1-1
Map

(Source: Reference 10)

To the east, the site is bounded by property owned by the Tennessee Valley Authority (east of State Highway 33, Wilson Dam Road). To the north the facility is bounded by an Air Products, Inc. industrial facility, and privately owned agricultural and commercial properties are located east and south of the site. The OxyChem property boundaries are shown in Figure II-1 (see page II-3) (Reference 10).

Prior to 1952, the site was occupied by undeveloped woodlands. The plant was originally constructed for the United States government in 1952 by the Monsanto Corporation and sold to Diamond Shamrock Chemicals Company in 1955. Diamond Shamrock subsequently sold the facility to OxyChem in 1986 (Reference 46). Since facility start-up, the plant has been exclusively dedicated to chlor-alkali production processes.

C. Process Description

The OxyChem facility currently uses potassium chloride (KCl) salt as a feedstock to generate potassium hydroxide (KOH, i.e., caustic potash) and chlorine (Cl_2) by an electrolytic process. From 1953 to 1976, NaCl was used as the sole process feedstock to produce chlorine and sodium hydroxide (NaOH) as primary products. KCl has been used as a feedstock since 1976, and NaCl was discontinued as a feedstock in 1991. According to facility personnel, NaCl materials were maintained in uncovered storage piles from the beginning of facility operations until NaCl feedstock use was discontinued in 1991. Covered storage piles of KCl were maintained on the facility grounds from 1976 to 1991. KCl now enters the production process after direct off-loading from railcars.

Feedstock KCl is dissolved and purified in water (or depleted brine) to produce a salt-saturated brine solution. The brine passes to large clarifier tanks to allow additional precipitation. Subsequently, the brine flows through a series of sand clarifier filters to capture additional brine sludge materials.

Following saturation and purification, the purified brines are piped to the mercury cell room and variously distributed to the facility's 116 electrolytic cells. The cells employ dimensionally stable anodes and free-flowing mercury cathodes to disassociate the KCl into its respective ions, which are collected as chlorine gas and a potassium-mercury amalgam. At maximum capacity, the facility is capable of generating and processing approximately 400 tons per day of chlorine and 650 tons per day of KOH (from the dissociation of the potassium-mercury amalgam). Incidental quantities of hydrogen gas (H_2) are also generated in side reactions of the electrolytic process and during the decomposition of the potassium-mercury amalgam (described below).

The chlorine gas, which is water-saturated upon collection from the electrolytic cells, undergoes cooling via noncontact waters piped from the Tennessee River. Additional cooling is provided by freon refrigeration chilling units. The chilled gas is piped to drying towers where it is treated with 98% sulfuric acid (H_2SO_4) to remove excess water. It is then compressed and refrigerated further to form a liquified chlorine product which is shipped offsite via rail tank cars.

The potassium-mercury amalgam generated by the electrolytic process is piped to decomposer tanks where the amalgam and input water are mixed over the surface of iron-impregnated carbon graphite packing. The hydrolysis of input water results in the generation of KOH. Each of the 116 electrolytic cells has a corresponding decomposer tank. The KOH is either sold as product or used in the production of potassium carbonate (K_2CO_3). Potassium carbonate production is accomplished in fluidized beds in which carbon dioxide (CO_2), produced onsite from the combustion of natural gas, reacts with KOH to form product potassium carbonate.

Hydrogen gas collected from the electrolytic process is cooled, compressed and carbon filtered to remove residual mercury. Product hydrogen is piped to the adjacent Air Products facility located immediately north of the OxyChem plant.

The electrolytic process requires large quantities of electricity. Electric power is supplied by the Tennessee Valley Authority (TVA). The incoming electricity arrives at the facility electric substation located immediately east of the Mercury Cell Building. Electric current is processed through a series of transformers to obtain direct current (D.C.) power at the appropriate voltage and amperage for use by the electrolytic cells.

D. Current Waste Management Practices

Primary waste streams generated at the OxyChem facility result from the brine purification process, routine process area washdown, and the removal of residual contaminant mercury from product materials (chlorine, KOH, and hydrogen). Throughout the operational lifetime of the facility, the types of wastes generated have remained fairly constant. However, waste management practices have evolved significantly over that same time period.

Brine sludge materials (K071) generated during the brine saturation/purification process are, and have been, the primary waste (by volume) produced by the OxyChem facility. Sludge materials are primarily composed of precipitated metal hydroxides and calcium chloride generated during the brine purification process. However, the recycling of depleted brine also results in the entrapment of mercury in the brine sludge materials. Aggregated brine impurities are periodically backwashed from the Brine Filters and combined with the coarser clarifier tank precipitates. The sludge materials are then passed through the Wastewater Treatment Frame Filter Presses (SWMU 17) for dewatering. Since the saturation and clarification steps utilize contact process brine waters recycled from the cell room, the brine sludge is contaminated with mercury at an average concentration of 10 ppb (according to facility personnel). Precipitate also accumulates in the bottom of the Brine Saturator Tanks. These brine sludges are stored in covered rolloffs and drums at the Hazardous Waste Roll-Off Pad (SWMU 11) prior to being shipped to a RCRA permitted landfill facility.

The removal of residual mercury to obtain purified product materials is accomplished by means of carbon adsorption. The facility generates mercury-laden carbon materials from several sources. The potassium-mercury amalgam decomposition step is performed in the decomposer tanks. These tanks are therefore the primary mercury recovery units. Residual mercury is also removed from KOH by carbon-adsorption in Funda and Adams filter units. Hydrogen gas is purified of residual mercury in hydrogen adsorber units, which are also carbon-filter units.

Mercury-laden carbon materials from the carbon filtration units discussed above are transferred to the Mercury Retort Tanks (SWMU 9). The Retort units use furnace-generated heat to volatilize mercury from the carbon materials. The mercury vapor is condensed in a water scrubber and piped to the adjacent Mercury Collection Vessel (SWMU 10), from which it is recycled back to the electrolytic production process. The retorted carbon materials contain residual quantities of nonrecoverable mercury and are classified as K106 waste. All such wastes are transferred to short-term storage at the facility Hazardous Waste Roll-Off Pad (SWMU 11) for subsequent disposal at athe hazardous waste landfill at Emelle, Alabama.

Mercury wastewaters are generated in the mercury cell room from two sources: purging of water used as vapor seals on electrolytic cell endboxes; and wash downs of the cell building as required by National Emission Standards for Hazardous Air Pollutants (NESHAPS) regulations. These waste streams are routed to the facility wastewater treatment plant (WWTP) directly or after temporary storage in a 500,000-gallon Wastewater Storage Tank (SWMU 19). Purged vapor seal waters are routed by pipe to storage or treatment. Cell room wash down waters flow to the Mercury Cell Room Trench System (SWMU 7), are collected at the cell room sump, and are then transferred by pipe to either storage or treatment. Additional mercury-bearing waste streams generated by rain or wash down in the brine and caustic filtration process areas of the facility are collected in the Industrial Sewer System (SWMU

14) and routed for treatment or temporary storage. The Industrial Sewer is shown in Figure II-2.

The facility WWTP has been in operation since 1974. Mercury-contaminated wastewaters are directed to a Hydrazine Reaction Tank (SWMU 20) where hydrazine, a reducing agent, is added to precipitate mercury to a filterable form. According to facility personnel the hydrazine used in the treatment process is readily degradable to nitrogen and hydrogen and is not detected as a waste constituent. Hydrazine-treated wastewaters are then passed through the Wastewater Treatment Frame Filter Presses (SWMU 17) for collection of wastewater treatment sludge. The filtered effluent is then passed through Carbon Polishing Towers (SWMU 21) for final polishing before discharge via the Industrial Sewer System (SWMU 14) to the facility's NPDES Outfall Ditch (SWMU 16). These treated wastewaters are routinely monitored for pH, chlorides and mercury according to the requirements of the facility's NPDES permit (Reference 40).

The primary liquefaction of chlorine gas is an efficient process which does not generate significant quantities of waste. The freon used in the chlorine liquefaction system is recovered and recirculated in a closed-loop system. Sulfuric acid used in the dewatering of chlorine is recovered and sold as dilute acid. Residual impurities accumulating in the chlorine drying towers are emptied from the tower. Although facility personnel were unable to characterize or quantify the waste materials removed from the drying towers, they stated that such materials were generated only in insignificant quantities, and that the removal of such residual materials occurred only on an infrequent and irregular basis (i.e., every few years). Any such wastes removed from those process units are sent for disposal at a RCRA-permitted landfill.

Secondary recovery of chlorine vapors generates significant quantities of a hazardous waste (F001 - spent halogenated solvents and/or still bottoms from such solvents). The recovery system collects chlorine gas from a number of sources, including off-gas from the primary liquification process, gas from returned chlorine tank cars, residual gas from weigh tanks, and gas from the OxyChem dock area on the Tennessee River. The collected gaseous chlorine is pressurized, chilled and transferred to the Carbon Tetrachloride Stripper Unit (SWMU 22), where the chlorine is solubilized by carbon tetrachloride (CH_4Cl_2). This Stripper, which is a packed distillation unit, differentially volatilizes and recondenses the solvent-solute mixture to purify and recover the chlorine gas. Accumulated wastes (F001 waste, distillation solvent and still bottoms) are removed from the unit during routine maintenance operations. All such collected wastes are stored at the facility's Hazardous Waste Roll-off Pad (SWMU 11) until shipment to a permitted disposal facility.

Figure II-2

Plant Industrial Sewer System

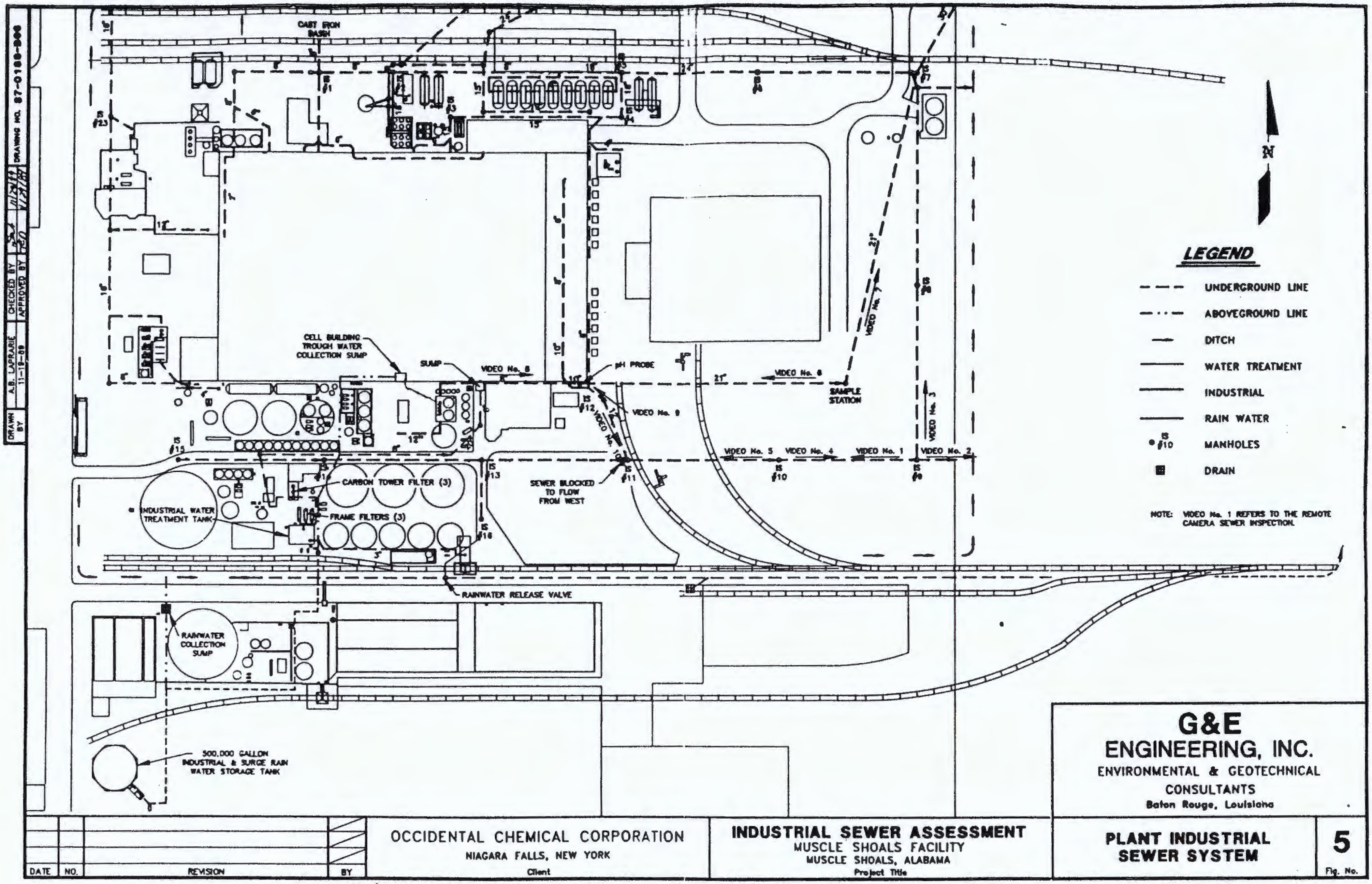


Figure II–2
Plant Industrial Sewer System

(Source: Reference 24)

Wastewaters are also generated at the plant Emergency Chlorine Scrubber Tanks (SWMU 12). According to facility personnel, chlorine production lines are pressurized and are designed so that it is not possible to simultaneously shut down all components of the system. Thus, in the event of equipment failure or malfunction (which periodically occurs in various downstream production areas), it becomes necessary to enact emergency diversions of chlorine from upstream production line areas to prevent a release of chlorine to the environment. Those diverted chlorine materials are sent to the emergency scrubber tanks where the gaseous chlorine is mixed with 20% sodium hydroxide (NaOH) to produce sodium hypoclorite (NaOCl, i.e., bleach). Upon depletion of the NaOH, the scrubber solution is piped to the adjacent Scrubber Solution Treatment Tanks (SWMU 13), where it is treated with sodium sulfite (Na_2SO_3). According to facility personnel, the bleach in the scrubber solution is thus degraded to nonhazardous NaCl and sodium sulfate (Na_2So_4) constituents prior to its release to the Industrial Sewer (SWMU 14) immediately upgradient of the NPDES Outfall Ditch (SWMU 16).

The generation of waste materials in the potassium carbonate fluidized bed production process is extremely minimal, according to facility personnel. However, the facility does operate scrubber systems to minimize particulate and nuisance dust emissions (Reference 44).

As of June 1987, the OxyChem facility ceased to utilize electric power transformers containing PCB materials (Reference 19). No wastes associated with the conversion and usage of electricity at the facility have been identified.

E. Past Waste Management Practices

Facility waste management practices have undergone significant changes since the beginning of plant operations in 1953. Brine sludges were originally dewatered in Sludge Pad Units (SWMU 6) located southeast of the mercury cell room. The sludge pads consist of sloped concrete pads which allowed excess brine fluids to drain off. The decanted brine fluids were recovered as reusable brine. At the time of the VSI, the facility still had one sludge pad in operation. According to facility personnel, the sludge pads were no longer routinely used. However, repairs on one of the clarifier tanks necessitated the temporary use of the pad. The facility plans to disassemble the pads in the near future, according to facility personnel.

From 1955 to February 1980, solid wastes generated at the facility, including NaCl brine sludges, KCl brine sludges, retorted carbon filter material and cell room sludges, and miscellaneous plant debris were disposed onsite in a pre-RCRA landfill (Reference 10). The Landfill (SWMU 1) became inoperative in 1980. Since 1980, all solid wastes generated by plant processes have reportedly been shipped offsite for disposal. However, the facility still possesses a junkyard area used for long-term storage of defunct equipment (AOC A) and an area in the Former North Impounding Basin (SWMU 3) just north of the junkyard where there were piles of both excavated soil (from elsewhere in the plant) and some construction debris at the time of the VSI.

Management of facility wastewaters has varied over the years as the facility gradually adapted its management practices in response to regulatory requirements. From 1953 to 1969, untreated facility wastewaters and noncontact process waters were routed through the Industrial Sewer System (SWMU 14) directly to the Old East Outfall Ditch (SWMU 15) and the Original Pond Creek Tributary. The tributary was also the primary receptor for facility stormwater runoff. The original bed for the tributary is shown in the site plan (Figure II-3) and a schematic diagram of facility sewer lines discharging to facility surface drainage areas is shown in Figure II-2, see page II-8.

This tributary stream formerly flowed roughly east to west and was centrally located in the area eventually occupied by the Former North Impounding Basin (SWMU 3). According to facility personnel, mercury concentrations in wastewaters generated during that period are believed to have averaged approximately two ppm.

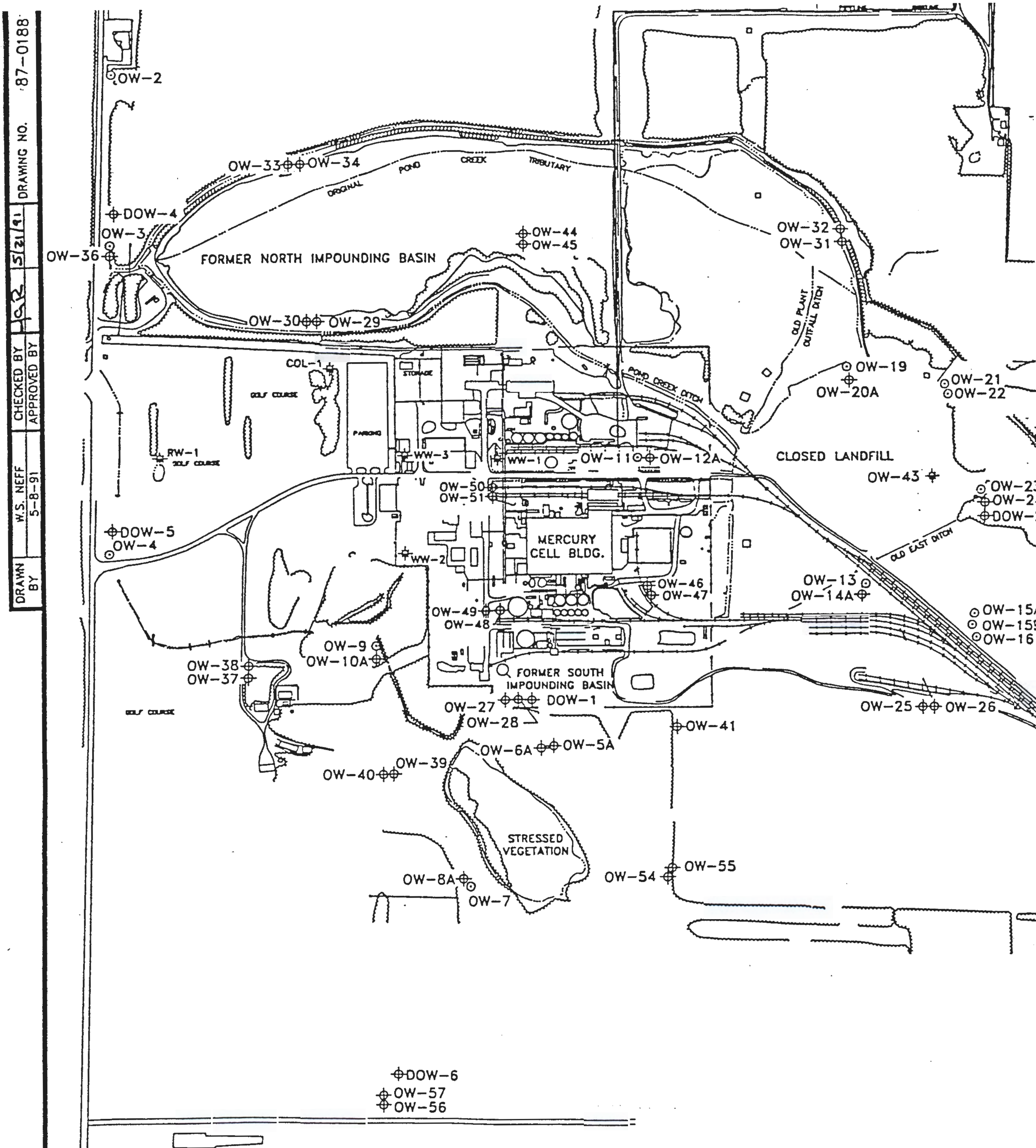
In 1970, a dam was constructed across the original Pond Creek tributary near the northwestern facility boundary and immediately east of Wilson Dam Road. The construction of the dam, which is currently still in existence, resulted in the creation of a surface impoundment identified as the North Impounding Basin (SWMU 3). From 1970 to 1971, the facility discharged waters from the North Impounding Basin to the downgradient end of the tributary below the dam. Discharge of those waters was reportedly done on a metered basis to comply with applicable discharge limits for mercury.

In 1971, the facility constructed a new outfall ditch south of the North Impounding Basin (SWMU 3). This ditch is identified as the NPDES Outfall Ditch (SWMU 16). At that time, the Old Pond Creek Tributary was routed to the north of the North Impounding Basin (see the site plan in Figure II-3). Following the construction of the NPDES Outfall Ditch, the diverted tributary and the North Impounding Basin were isolated from routine exposure to facility wastewaters. The NPDES Outfall Ditch has been in continuous operation since its construction in 1971.

The facility constructed a second surface impoundment south of the mercury cell room building in 1970. That unit was identified as the South Impounding Basin (SWMU 2). From 1970 to 1974, the unit was used for the treatment and storage of plant process wastewaters, which were subsequently released to the NPDES

Figure II-3

Site Plan



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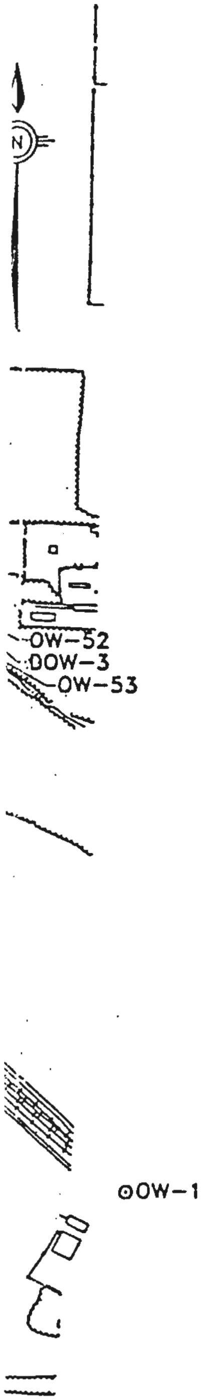
OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

Client

Figu

Site



LEGEND

- ⊙ EXISTING MONITORING WELL (UPGRADED)
- ⌖ NEW MONITOR WELL
- ⌖ MONITOR WELL/WATER WELL (ABANDONED/CLOSED)

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS. EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS. WELL NOS. OW-17, OW-18, OW-35 AND OW-42 NOT USED.

0 feet 600
SCALE

G&E
ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

GROUNDWATER ASSESSMENT MUSCLE SHOALS FACILITY MUSCLE SHOALS, ALABAMA Project Title	**SITE PLAN**	**2** Fig. No.

II-3
Plan

(Source: Reference 1)

Outfall Ditch via the Old East Outfall Ditch (SWMU 15). Between 1974 and 1976, the South Impounding Basin stored excess cell room process brine. The berms of the South Impounding Basin were pushed in to bury the unit in 1980.

The Former Hypalon-Lined Storage Tank (SWMU 8) received excess cell room brine waters between 1976 and 1981. The tank was located immediately west of the Former South Impounding Basin (SWMU 2) and was disassembled in October 1983 (Reference 28).

From approximately 1980 to June 1987, the OxyChem facility maintained a PCB Storage Area (SWMU 18). This enclosed storage building was reportedly used to store all PCB materials and other PCB-contaminated materials and equipment. The unit was subject to routine inspection during its operational period. The storage building was converted to nonhazardous functions upon the discontinuation of PCB usage at the facility. Facility representatives have stated that they have no knowledge of how PCB materials and wastes were managed at the facility prior to 1980.

F. Regulatory History

This section presents the regulatory history of the facility, including previous investigations, closure activities, and information on NPDES and air permits granted to the facility. In addition, the facility's unsuccessful attempt to delist its K106 waste is also discussed.

1. Previous Investigations

In 1980, the Alabama Department of Public Health expressed concerns regarding the plant Landfill (SWMU 1) and requested that groundwater monitoring wells be placed around this unit (Reference 45). The facility responded by retaining Woodward-Clyde Consultants to conduct a site investigation and to install piezometers and four groundwater monitoring wells. Woodward-Clyde installed an additional 25 monitoring wells in 1981. In 1985, the Alabama Department of Environmental Management (ADEM) determined that the existing monitoring wells were incapable of detecting possible leakage from the landfill and requested the installation of new monitoring wells (Reference 46). Subsequently, the facility retained Dames and Moore, Inc. to evaluate the groundwater monitoring system installed by Woodward-Clyde.

Dames and Moore concluded that the wells were of poor construction and not capable of producing reliable groundwater data (Reference 2). As a result, G&E Engineering, Inc. was retained by the facility in November, 1987 to conduct a more comprehensive evaluation of the site (Reference 10).

These site investigations are briefly described below:

1. In 1980 and 1981, Woodward-Clyde Consultants, Inc. conducted studies to determine the quality and direction of groundwater flow, evaluate the thickness and effectiveness of the landfill cover, and examine surface soils and sediments for contamination. Data from the studies were used to upgrade the landfill cover and to support the contention that the North Impounding Basin (SWMU 3) posed no harm to the environment.

2. In 1987, Dames and Moore evaluated the role of the landfill as a source of contamination. This study documented mercury and chloride contamination of groundwater.

3. In 1987, G&E Engineering, Inc. began a series of site investigations to evaluate contamination of soils, sediments, surface water and groundwater. In addition, the landfill cover was upgraded and recommendations were made for no remediation of existing site contamination.

The study conducted by G&E revealed the presence of elevated levels of mercury, cadmium and chlorides in the underlying groundwaters of the Tuscumbia/Fort Payne aquifer, which is regionally utilized as a potable water source. Groundwater samples obtained between October 1988 and January 1989 revealed contaminant levels as high as 93,500 ppm chloride, 340 ppb mercury, and 330 ppb cadmium (Reference 10).

2. <u>RCRA and Closure Activities</u>

The facility submitted its initial RCRA Part A Hazardous Waste Permit Application on November 18, 1980 (Reference 29). The facility formally withdrew its Part A Application on October 22, 1984, instead electing to close all long-term storage areas with the intent of being classified solely as a hazardous waste generator (Reference 30). In pursuit of that goal, the facility obtained certified closure from ADEM for Waste Piles A and B, (SWMU 25) on June 2, 1986 (Reference 27). EPA Region IV and the State of Alabama have requested that the facility submit a Part B Hazardous Waste Post-Closure Permit Application for closed Waste Pile B (Reference 31).

On August 27, 1990, ADEM issued a Notice of Violation to the Muscle Shoals Plant (Reference 15), as specified under Title 22 of the Code of Alabama. The Notice of Violation was issued on the basis of groundwater monitoring analytical results obtained during site investigation activities initiated by G&E Engineering in 1987. As a result, the facility is now under a compliance schedule stipulated in an Administrative Order to complete additional groundwater assessment and to propose and implement corrective action (Reference 15).

3. <u>NPDES Permit and Air Permits</u>

Effluent from the Occidental Muscle Shoals Plant is regulated under NPDES Permit No. AL0000213, which was issued to the facility on May 12, 1989. This permit became effective as of May 15, 1989 and will expire on May 14, 1994. The authorized discharge point is located near the northwestern corner of the facility where the NPDES Outfall Ditch (SWMU 16) passes under Wilson Dam Road and flows into Pond Creek (see Appendix C for location). The NPDES Outfall Ditch receives total facility discharge waters (DSN001) consisting of stormwater runoff, and processed wastewaters (DSN001A) from the plant wastewater treatment facility (SWMUs 17, 19-22) and hypochlorite decomposition system (SWMUs 12 and 13). The effluent is monitored for total flow, total suspended solids, mercury, nickel, and total residual chlorine (Reference 41).

The Occidental Muscle Shoals plant has been issued operating permits for nine air emission control sources, including the following air permits (Reference 44):

- Air Permit Number 701-002-X008, issued October 7, 1988 (potassium carbonate plant wet process scrubber with nuisance dust scrubber);
- Air Permit Number 701-0002-Z004, issued March 7, 1988 (hydrogen-fired boiler);
- Air Permit Number 701-0002-Z006, issued March 7, 1988 (Fuel oil/natural gas-fired boiler);
- Air Permit Number 701-0002-Z007 issued March 7, 1988 (hydrogen-fired boiler);
- Air Permit Number 701-0002-X009, issued October 31, 1991 (potassium carbonate plant wet process scrubber and nuisance dust scrubber);
- Air Permit Number 701-0002-Z001, issued October 31, 1991 (potassium carbonate plant wet scrubbers);
- Air Permit Number 701-00002-Z002, issued October 7, 1988 (potassium carbonate plant wet process scrubber and nuisance scrubber);

- Air Permit Number 701-0002-Z003, issued October 7, 1988 (potassium carbonate plant wet process scrubber and nuisance dust scrubber); and

- Air Permit Number 701-0002-Z005, issued March 7, 1988 (chlorine recovery and hydrogen processing systems).

F. Environmental and Demographic Setting

1. Meteorology

Colbert county is located in the extreme northwest corner of Alabama, and is characterized by a mild, humid, subtropical climate. The average annual temperature is 60.8√F.

Precipitation is usually greatest during the fall and winter months (November through March). The average annual precipitation is 51.58 inches; however, monthly precipitation values can vary widely. In the past three years, monthly rainfall amounts have ranged from 0.00 inches in June 1988 to 20.73 inches in December 1990 (References 10 and 1).

2. Floodplain and Surface Waters

Oxychem is surrounded by a gently rolling terrain, with little topographic variation. Site elevations range from a high of 540 feet above mean sea level to the south and west of the facility, to a low of 518 feet above mean sea level along the drainage feature (Pond Creek Ditch) which traverses the site from southeast to northwest (Figure II-3, page II-11).

Surface water drainage patterns at the facility have changed over time. From 1955 until 1969, both process wastewater and surface runoff were discharged through a series of ditches and creeks to the Tennessee River. The water discharge pathway began where the industrial sewers and stormwater discharged into the Old East Outfall Ditch (SWMU 15; see location in Appendix C). This ditch discharged into the Old Plant Outfall Ditch (Figure II-3). This ditch fed into the Original Pond Creek Tributary (Figure II-3), which later joined with Pond Creek (References 10 and 62). Pond Creek waters ultimately discharges into the Tennessee River at a location approximately two miles to the north of the facility. The surface drainage patterns are illustrated in Figure II-4.

A lowering of the drinking water standards for mercury in 1969 resulted in a modification of the facility's process water and surface runoff discharge routes. These modifications were implemented in 1970. The Original Pond Creek Tributary was dammed along the western boundary of the facility. This action resulted

Figure II-4

Surface Drainage Pattern

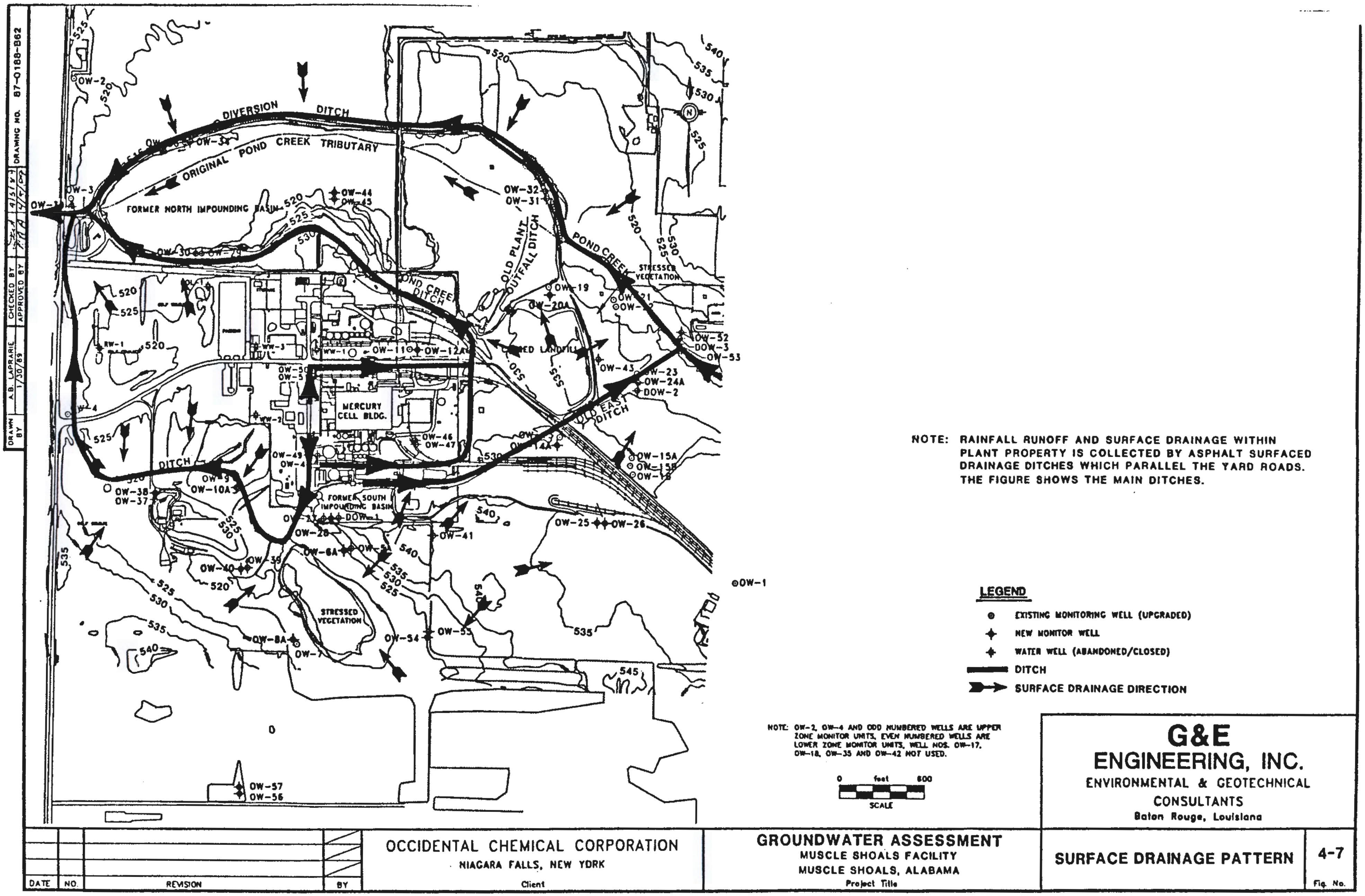


Figure II–4
Surface Drainage Pattern

(Source: Reference 10)

in the accumulation of process wastewater and surface runoff in a surface water impoundment, which was later named the Former North Impounding Basin (SWMU 3). Water from the Former North Impounding Basin (SWMU 3) was treated with sodium bisulfide to allow for the precipitation of mercury prior to discharge to Pond Creek. In addition, the Former South Impounding Basin (SWMU 2) was constructed to receive plant wastewater for treatment prior to surface water discharge. A final surface water discharge modification involved the excavation of a new NPDES Outfall Ditch (SWMU 16), which was located south of the Former North Impounding Basin (SWMU 3). Use of the Former North Impounding Basin for process wastewater and surface runoff control was terminated once the NPDES Outfall Ditch was completed in 1971 (Reference 10).

With the exception of the modified process wastewater/storm water discharge system, surface water drainage at the facility generally conforms with the surface topography. Figure II-4 illustrates the surface drainage patterns at the site. Other facility discharge pathways include the Old East Ditch (AOC D), which is located to the east of the facility process area, an unnamed ditch which is located to the west of the plant, and a Diversion Ditch which is located directly north of Original Pond Creek Tributary. Surface runoff also drains to the swampy area of Stressed Vegetation (SWMU 24) south of the Former South Impounding Basin (SWMU 2).

The 100-year floodplain map for the Oxychem is presented as Figure II-5. Although some of the facility property [e.g., the Former North Impounding Basin (SWMU 3) and the Area of Stressed Vegetation (SWMU 24)] is located within the 100-year floodplain boundary, the facility process area does not lie within the flood-prone area. The 100-year flood elevation is approximately 523 ft above mean sea level (MSL)(Reference 10).

3. <u>Soils and Geology</u>

Soils underlying the Occidental Chemical facility consist of the Dewey, Abernathy, and Guthrie Series. Soils from the Dewey Series are the most predominant at the site. These soils are characterized by reddish brown, mottled yellow and gray clays, and are derived from the weathering of the underlying Tuscumbia Formation. These soils may also contain chert fragments, and iron or manganese concretions (Reference 10).

Soils of the Abernathy Series consist of sticky, light gray clay, and mottled yellow to rust brown gray clay. These soils are poorly drained, and tend to be concentrated in swales and topographic depressions within the Dewey soils (Reference 10).

Soils of the Guthrie Series consist of blue, gray, and brown clay. Like the Abernathy Series, these soils tend to be

Figure II-5

100-Year Floodplain

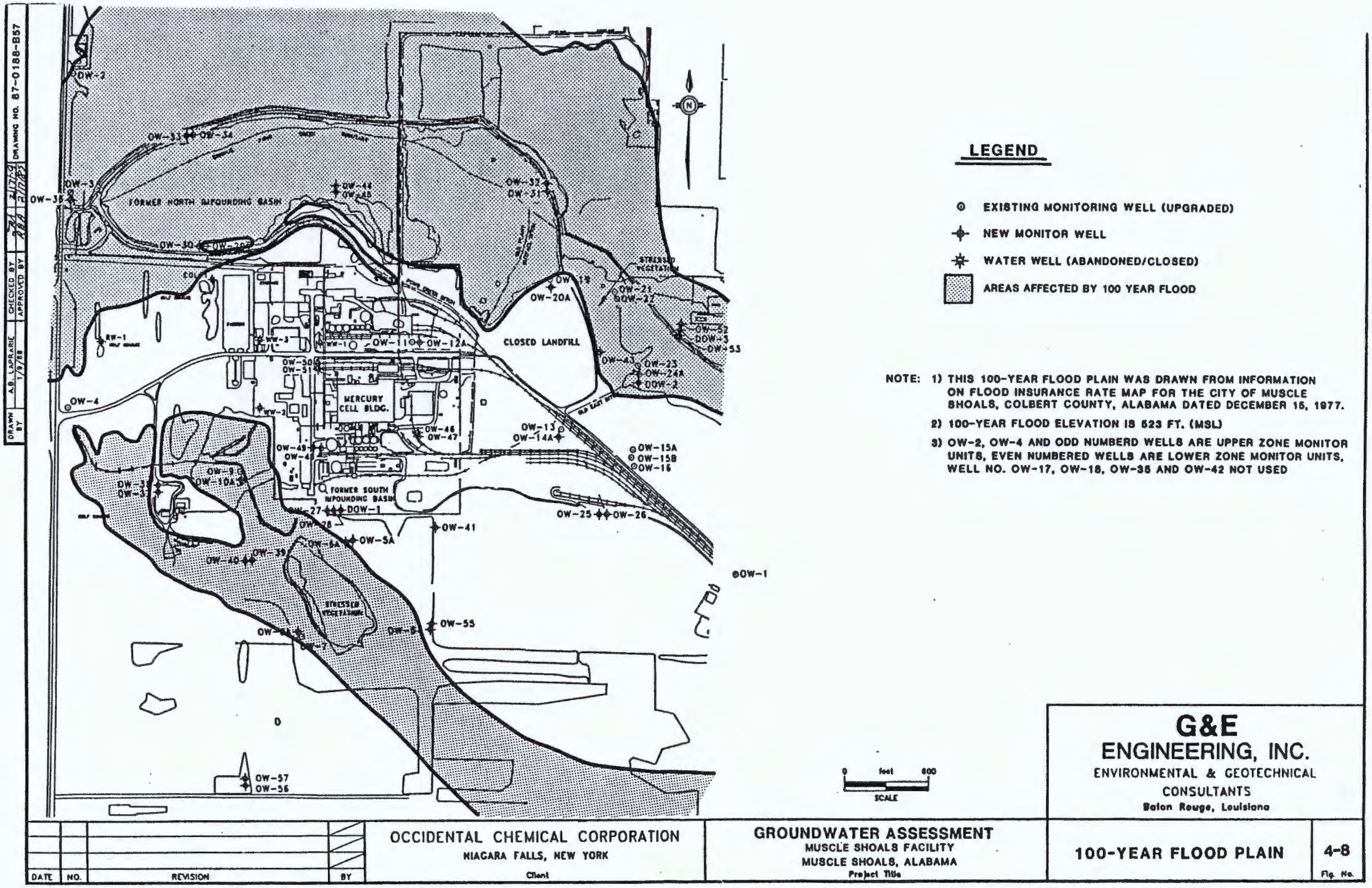


Figure II–5
100–Year Flood Plain

(Source: Reference 10)

concentrated in basins and swales, and are generally very poorly drained. As a result, they produce swampy areas of standing water during periods of frequent rainfall (Reference 10).

Oxychem is located within the Interior Low Plateaus physiographic province. The topography surrounding the plant is gently rolling. According to published reports, the topographic relief in the area is attributable to solution of the subsurface carbonate units (with subsequent collapse/settling of the overburden), rather than surface erosional effects. The karst setting has resulted in the formation of numerous sinkholes in the area surrounding the facility (Reference 10).

The subsurface geology underlying the facility is characterized by several hundred feet of unconsolidated to consolidated sedimentary rocks, which dip to the south and southwest at a gradient of 20 feet per mile. The regional stratigraphic dip is attributed to the structural influence of the Nashville Dome, located approximately 100 miles to the northeast (Reference 10).

The regional subsurface stratigraphy is comprised of three distinct units. Geological descriptions of these units were extracted predominantly from References 1 and 10. The uppermost unit is referred to as the regolith, and consists of the surficial soils, unconsolidated soil and rock debris, alluvial soils, colluvium, and terrace deposits. The lithology consists primarily of unstratified reddish-brown clay with varying amounts of chert; however, lenses and beds of sand and gravel can be found within the terrace deposits. The permeability of the regolith can be variable as a result of the lithological heterogeneity of the unit. The regolith is thickest in topographically high areas (i.e., ridge tops) and is thinnest in stream valleys. At the facility, the regolith ranges from 45 to 89 feet in thickness (Reference 10).

The regolith overlies up to 200 feet of Mississippian age limestone. This second unit, referred to as the Tuscumbia Limestone, consists of a light gray, medium bedded, hard, dense, finely crystalline limestone. Lenses and nodules of chert occur throughout the unit, while beds of greenish gray shale occur less frequently. The thickness of the unit varies due to differential weathering of the upper bedrock surface. At the Occidental Chemical Corporation facility, the Tuscumbia averages less than 100 feet thick (Reference 10).

The Tuscumbia Formation conformably overlies the third unit, which is referred to as the Fort Payne Chert. This Mississippian age unit consists of light gray to white crystalline limestone interbedded with lenses and nodules of light gray to black chert. The thickness of the Fort Payne Chert ranges from 162 to 207 feet, with an average thickness of 186 feet (Reference 10).

East to west geologic cross sections exhibiting the site specific subsurface stratigraphy at the facility are presented in Figure II-6.

As part of 1988 site assessment activities (Reference 10) soil samples were collected from locations across the facility. Sample analyses for mercury and chlorides yielded soil sample concentrations ranging from less than 0.02 to 200 mg/kg, and 5 to 43,500 mg/kg, respectively (Figures II-7 and II-8).

4. <u>Groundwater</u>

Groundwater is present in both the unconsolidated overburden (regolith), and in the consolidated limestone bedrock underlying the Occidental Chemical facility. Although these two intervals constitute the two uppermost aquifers in the region, groundwater has been monitored in previous studies from three distinct zones within these aquifers. These include the Upper Zone, which includes the regolith, the Lower Zone, which includes the upper 5 to 10 feet of the Tuscumbia Limestone bedrock, and the Deep Zone, which includes Tuscumbia Limestone bedrock intervals located deeper than 35 ft from the top of the unit. The remainder of this discussion will revolve around the three zones rather than on specific aquifers (Reference 10).

The hydrological characteristics of the Upper and Lower Zones differs as a result of the lithological differences between the units. Groundwater occurs in the regolith, or Upper Zone, under unconfined conditions. Depth to the water table at the facility ranges from 5 to 25 ft, depending upon the season and location of the well. Recharge to the unit occurs from surface infiltration. Although the direction of groundwater flow in the Upper Zone generally conforms with the surface topography, a pronounced groundwater mound is present underneath the facility process area (Figure II-7). This mound is believed to be a result of direct infiltration from the nearly continuously filled drainage ditch system, and the absence of vegetation (Reference 10). At the facility, groundwater flows outward in a radial pattern from the process area. The regional groundwater flow patterns in the Upper Zone are to the north and west towards the Tennessee River. Field derived hydraulic conductivity values for the Upper Zone range from 9.6×10^{-4} to 1.0×10^{-5} centimeters per second (cm/sec). The Upper Zone hydraulic gradient ranges from 0.003 to 0.01 ft per ft (ft/ft), while the calculated groundwater flow velocity ranges from 1.2 to 400 ft per year (ft/year) (Reference 10).

Groundwater also occurs under unconfined conditions in the upper intervals of the Tuscumbia Limestone bedrock, or Lower Zone. Since the Upper and Lower Zones are not separated by a confining unit, they are in direct hydraulic communication. Recharge to the Lower Zone is through downward infiltration from the overlying

Figure II-6

East to West Geologic Cross Sections

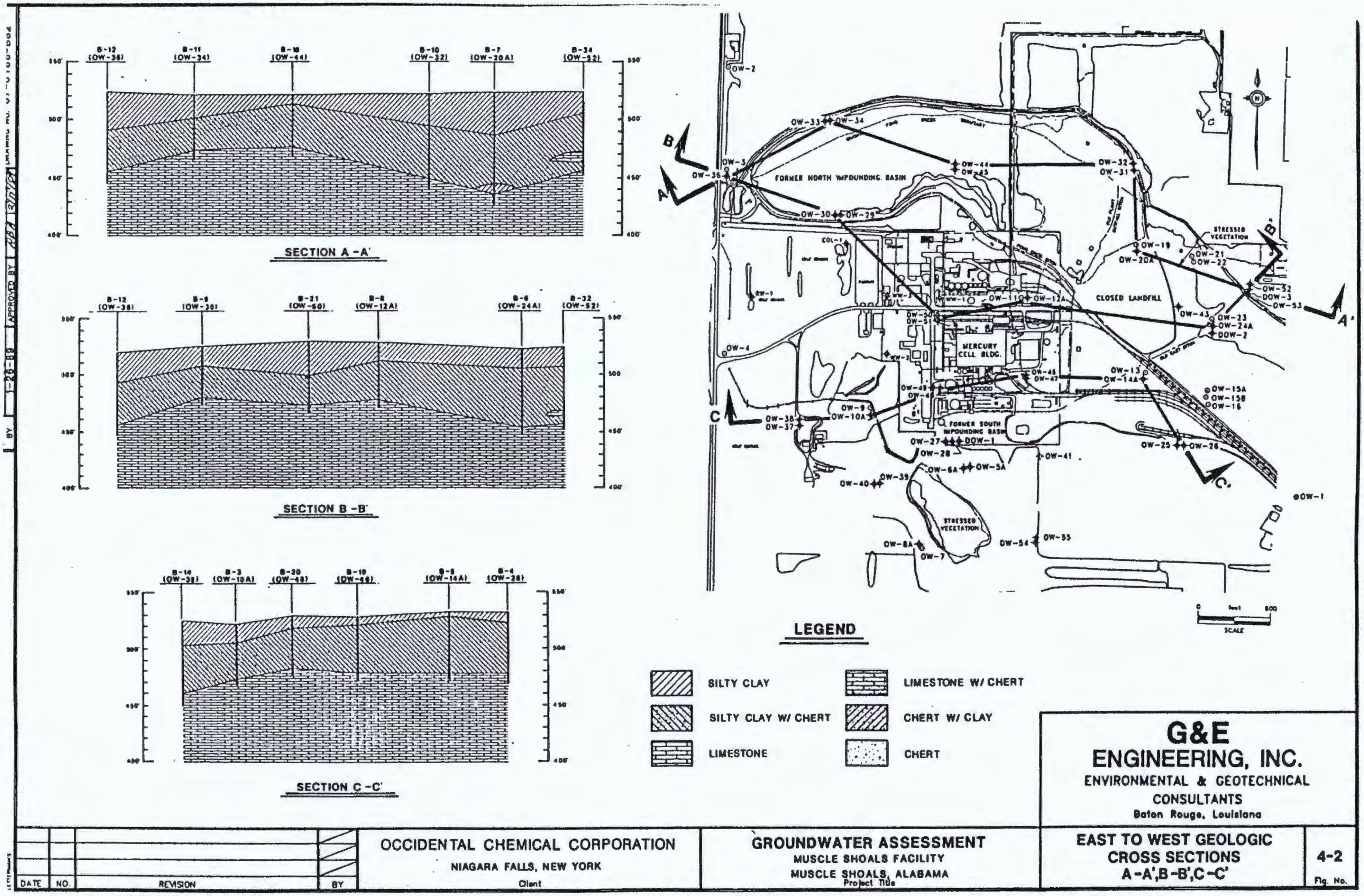


Figure II–6
East to West Geologic Cross Sections (Source: Reference 10)

Figure II-7

Site Mercury and Chlorine Soil Profiles

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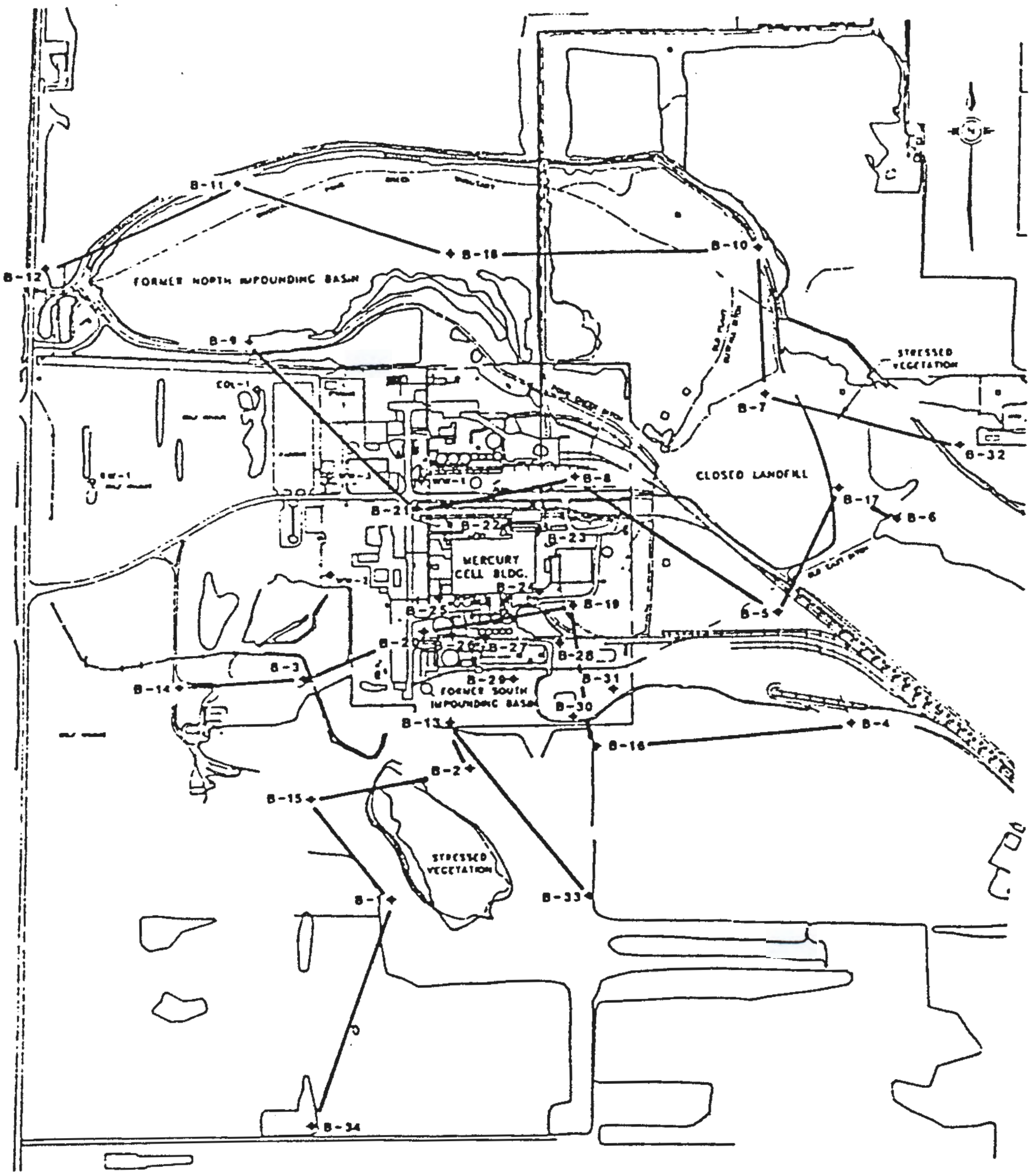
APPROVED BY
DRAWING NO. 87-0188-B



(OV-36)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.07	10
3 - 5	0.07	70
8 - 10	0.02	55
13 - 15	<0.02	30
18 - 20	<0.02	65
23 - 25	0.07	10
28 - 30	<0.02	<10
33 - 35	0.04	<10
38 - 40	0.05	<10
43 - 45	0.03	10
48 - 50	0.02	10
53 - 55	0.02	<10
58 - 60	0.05	<10

B-9
(OV-30)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.06	290
3 - 5	0.05	320
8 - 10	0.02	320
13 - 15	0.03	610
18 - 20	0.02	775
23 - 25	0.02	350
28 - 30	0.02	75
33 - 35	0.06	50
38 - 40	0.05	70

B-14
(OV-38)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.66	40
3 - 5	0.05	10
8 - 10	0.02	60
13 - 15	<0.02	55
18 - 20	<0.02	65
23 - 25	0.03	45
28 - 30	0.03	<10
33 - 35	0.03	<10
38 - 40	0.04	10
43 - 45	0.03	<10
48 - 50	0.02	<10
53 - 55	0.02	<10
58 - 60	<0.02	12
63 - 65	0.05	35

B-34
(OV-34)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.03	15
3 - 5	0.05	40
8 - 10	0.07	10
13 - 15	0.04	<10
18 - 20	0.03	<10
23 - 25	0.08	<10
28 - 30	0.07	<10
33 - 35	0.05	<10
48 - 50	0.05	10
58 - 60	0.02	20
63 - 65	0.03	40
67 - 69	0.13	<10

LEGEND

✦ SOIL BORING LOCATION

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Client

Fig
Site Hg &

(OW-34)

...th (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.03	135
3 - 5	0.02	55
8 - 10	<0.02	390
3 - 15	<0.02	280
8 - 20	<0.02	335
3 - 25	<0.02	45
8 - 30	<0.02	60
3 - 35	<0.02	270
8 - 40	0.03	205
3 - 45	0.06	115
8 - 49	<0.02	115

(OW-44)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.91	50
3 - 5	39.0	25
8 - 10	0.25	90
13 - 15	0.11	10
18 - 20	0.12	<10
23 - 25	0.05	<10
28 - 30	0.09	<10
33 - 35	0.59	<10
38.5 - 40	0.28	<10

(OW-32)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	67.0	70
3 - 5	5.3	60
8 - 10	0.03	81
13 - 15	<0.02	675
18 - 20	<0.02	170
23 - 25	<0.02	145
28 - 30	0.02	295
33 - 35	0.07	215
38 - 40	0.05	100
43.5 - 45	0.04	150
48 - 50	0.06	100
58 - 60	0.03	255
63 - 65	0.03	170
68 - 70	0.06	85

(OW-20A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.03	<10
3 - 5	<0.02	950
8 - 10	0.02	475
13 - 15	0.05	320
18 - 20	0.02	90
23 - 25	0.03	45
28 - 30	<0.02	55
33 - 35	0.13	70
38 - 40	0.02	50
43 - 45	0.02	65
48 - 50	0.07	55
62 - 63.5	0.02	15
73 - 75	0.09	70
78 - 80	0.03	40
83 - 85	0.02	35

(OW-52)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 3	0.04	<10
3 - 5	0.07	25
8 - 10	0.05	25
13 - 15	0.09	10
18 - 20	0.03	<10
23 - 25	0.11	<10
28 - 30	0.04	<10
33 - 35	0.06	<10
38 - 40	0.48	<10
43 - 45	0.17	<10
48 - 50	0.10	<10
53 - 55	0.10	<10
62 - 67	0.10	<10

B-21
(OW-50)

...th (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	21.0	<10
3 - 5	0.14	<10
8 - 10	0.03	<10
3 - 15	0.04	<10
8 - 20	0.03	110
3 - 25	0.03	330
8 - 30	0.06	200
3 - 35	0.05	85
8 - 40	0.03	<10
3 - 45	0.59	<10
3 - 55	0.09	555

B-8
(OW-12A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.16	40
3 - 5	0.18	40
8 - 10	0.15	20
13 - 15	0.13	20
18 - 20	0.12	25
23 - 25	0.15	50
52 - 58	0.25	185

B-5
(OW-24A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.033	<10
3 - 5	<0.02	50
8 - 10	0.03	60
13 - 15	<0.02	125
18 - 20	<0.02	205
23 - 25	<0.02	50
28 - 30	<0.02	<10
33 - 35	<0.02	<10
38 - 40	<0.02	<10
43 - 45	<0.02	100
48 - 50	0.02	215
53 - 55	0.05	250

B-17
(OW-43)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.57	9,000
3 - 5	0.08	11,500
8 - 10	0.65	350
13 - 15	0.05	<10
18 - 20	0.05	<10
23 - 25	0.08	<10
28 - 30	0.05	<10
33 - 35	0.07	30
38 - 40	0.08	340
43 - 45	0.09	110
48 - 50	0.11	110
53 - 55	0.12	175
58 - 60	0.08	225
63 - 65	0.08	1,120

B-6
(OW-24A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.04	325
3 - 5	0.04	765
8 - 10	0.02	35
13 - 15	0.05	10
18 - 20	0.05	50
23 - 25	0.04	40
28 - 30	0.02	<10
33 - 35	0.02	125
38 - 40	0.02	<10
43 - 45	<0.02	175
53 - 55	0.26	<10
53 - 65	0.02	<10

B-3
(OW-20A)

...th (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	<0.02	415
3 - 5	<0.02	640
- 10	<0.02	315
- 15	<0.02	430
- 20	0.02	1,450
- 25	0.05	1,000
- 30	0.05	180
- 35	0.02	265
- 40	<0.02	1,200
- 48	<0.02	800

B-20
(OW-48)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.0	4,400
3 - 5	0.35	2,050
8 - 10	0.08	6,850
13 - 15	0.03	7,000
18 - 20	0.02	16,200
23 - 25	0.05	10,200
28 - 30	0.13	4,300
33 - 35	0.10	3,550

B-19
(OW-46)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	33.0	100
3 - 5	0.72	120
8 - 10	0.61	2,200
13 - 15	0.46	13,000
15 - 16.5	0.06	20,200
22 - 24	0.14	28,500
33 - 35	0.13	493
38 - 40	0.11	1,985
43 - 45	0.74	3,280
46 - 49	0.05	6,750

B-16
(OW-41)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.07	10
3 - 5	0.05	30
8 - 10	0.04	15
13 - 15	0.04	<10
18 - 20	<0.02	15
23 - 25	0.07	10
28 - 30	0.04	<10
33 - 35	0.02	15
38 - 40	0.04	10
43 - 45	0.06	10
48 - 50	0.02	270

B-4
(OW-26)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.04	20
3 - 5	0.04	70
8 - 10	0.04	65
13 - 15	0.05	<10
18 - 20	0.05	50
23 - 25	0.05	<10
28 - 30	0.07	<10
33 - 35	0.05	40
38 - 40	0.05	95
43 - 45	0.03	35
48 - 50	0.13	60

B-7
(OW-8A)

...h (ft)	Hg (mg/kg)	Cl (mg/kg)
- 2	0.02	15
- 5	<0.02	135
- 10	0.02	180
- 15	0.07	115
- 20	0.02	140
- 25	<0.02	130
- 30	<0.02	5
- 35	<0.02	5
- 40	0.49	30
- 45	0.05	<1.0
- 50	0.02	10
- 55	0.03	<1.0
- 60	<0.02	<1.0
- 65	0.05	5
- 70.5	0.02	30

B-15
(OW-40)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.10	15
3 - 5	0.04	70
8 - 10	0.08	80
13 - 15	0.07	105
18 - 20	<0.02	35
23 - 25	0.10	135
28 - 30	0.07	30
33 - 35	0.05	<10
38 - 40	0.08	35
43 - 45	0.12	<100

B-2
(OW-6A)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.09	75
3 - 5	0.22	150
8 - 10	1.3	515
13 - 15	0.07	1,150
18 - 20	0.02	3,350
23 - 25	0.03	2,500
28.5 - 30	0.07	680
33.5 - 35	0.06	655
38 - 40	0.26	375
43 - 45	0.04	915
48 - 50	0.10	2,850

B-13
(OW-28)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.16	25
3 - 5	64.0	125
8 - 10	12.0	175
13 - 15	3.3	500
18 - 20	<0.02	3,000
23 - 25	<0.02	4,000
28 - 30	0.05	4,750
33.5 - 35	0.02	565
38 - 40	0.05	<10
43 - 45	<0.02	900
48.5 - 50	0.14	800
53 - 55	0.02	785

B-33
(OW-54)

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.04	<10
3 - 5	0.03	<10
8 - 10	0.03	<10
13 - 15	0.08	40
18 - 20	0.06	30
23 - 25	0.02	10
30 - 33	0.08	20
34 - 38	0.05	175
43 - 45	0.06	<10
48 - 50	0.03	75

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ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

GROUNDWATER ASSESSMENT
MUSCLE SHOALS FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

SITE HG AND CL SOIL PROFILES

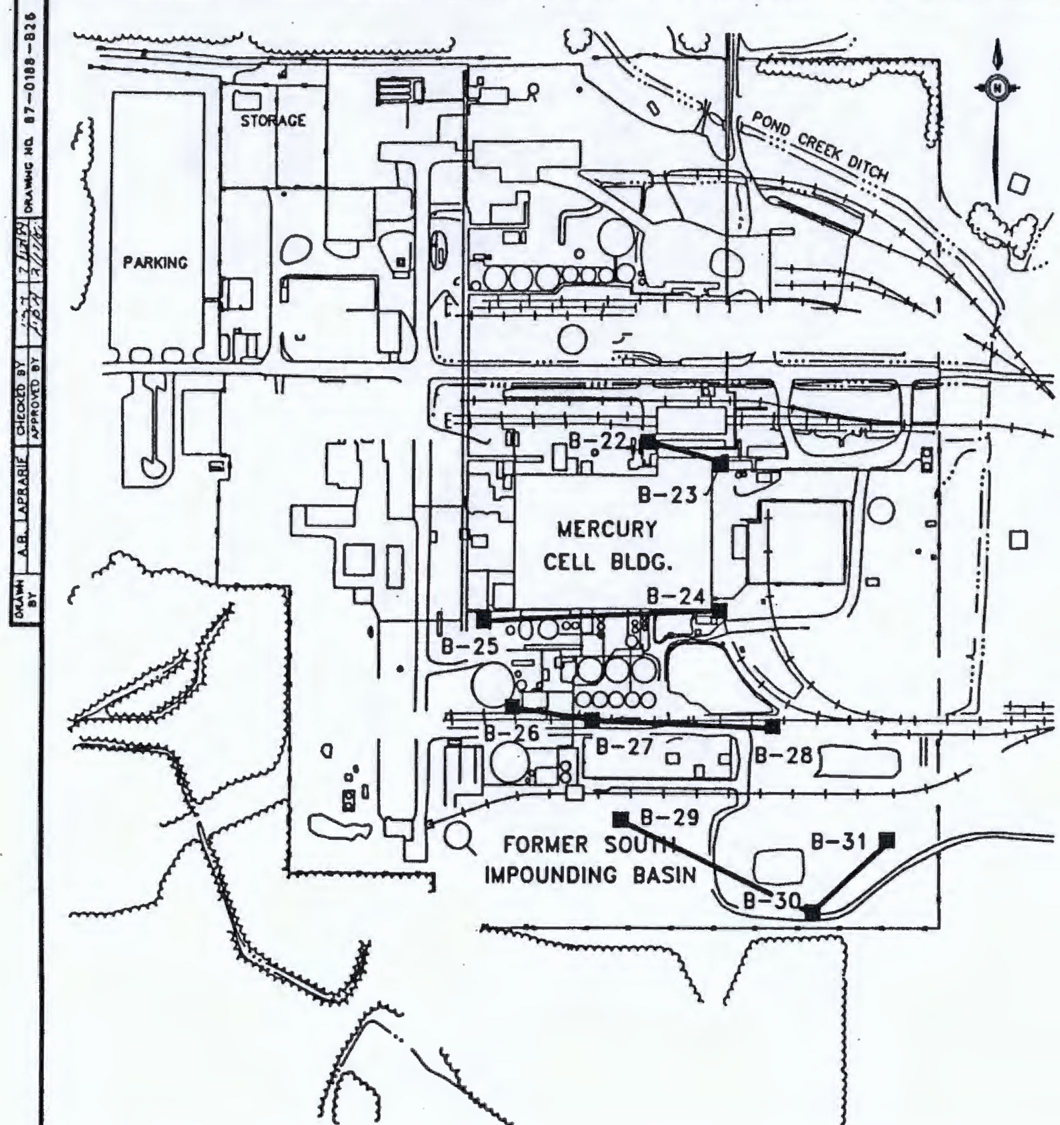
3-7
Fig. No.

II-7
Soil Profiles

(Source: Reference 10)

Figure II-8

Process Area Mercury and Chlorine Soil Profiles



B-22

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.1	<10
3 - 5	0.09	<10
8 - 10	0.07	<10
13 - 15	0.34	<10

B-23

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.09	60
3 - 5	0.85	80
8 - 10	0.56	140
13 - 15	0.11	265

B-25

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.09	590
3 - 5	1.7	670
8 - 10	0.42	1,350
13 - 15	0.34	1,450

B-24

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.08	850
3 - 5	0.50	1,210
8 - 10	0.11	4,850
13 - 15	0.11	5,100

B-26

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	46.0	4,450
3 - 5	0.87	2,200
8 - 10	0.39	6,400
13 - 15	0.17	12,000

B-27

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
3 - 5	0.23	10,100
8 - 10	0.10	24,700
13 - 15	0.32	28,000

B-28

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.05	6,250
3 - 5	0.16	8,750
8 - 10	0.19	32,200
13 - 15	0.16	43,500

B-29

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	200	120
3 - 5	9.4	90
8 - 10	41.0	870
13 - 15	2.6	910

B-30

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	1.3	115
3 - 5	0.11	1,100
8 - 10	0.07	320
13 - 15	0.04	110

B-31

Depth (ft)	Hg (mg/kg)	Cl (mg/kg)
0 - 2	0.34	20
3 - 5	0.05	20
8 - 10	0.07	20
13 - 15	0.07	520

LEGEND

■ SOIL EXPLORATION BORING

0 feet 250
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATION
NIAGARA FALLS, NEW YORK
Client

GROUNDWATER ASSESSMENT
MUSCLE SHOALS FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

PROCESS AREA
HG AND CL SOIL PROFILES

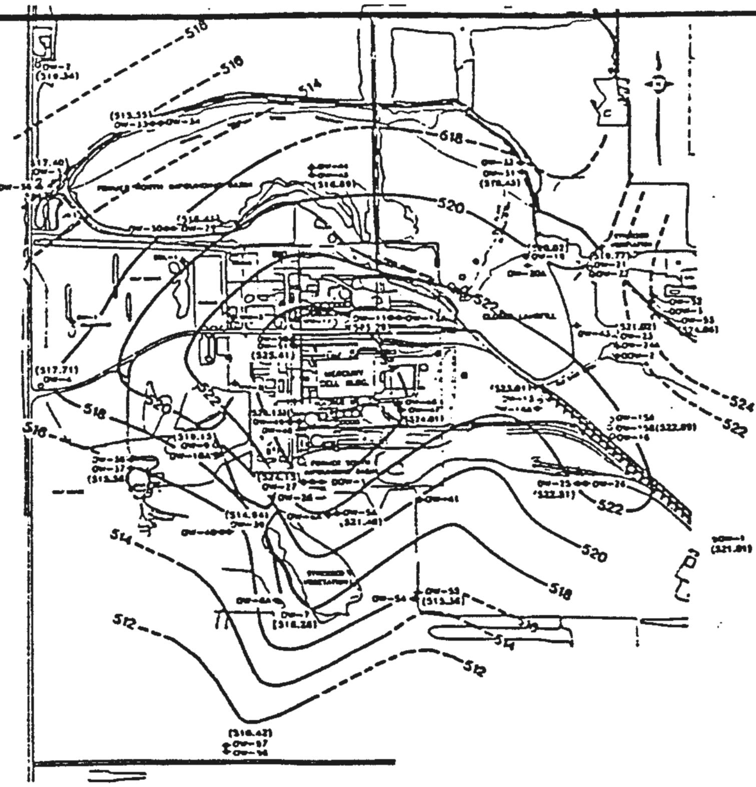
3-8
Fig. No.

Figure II–8
Process Area Hg & Cl Soil Profiles

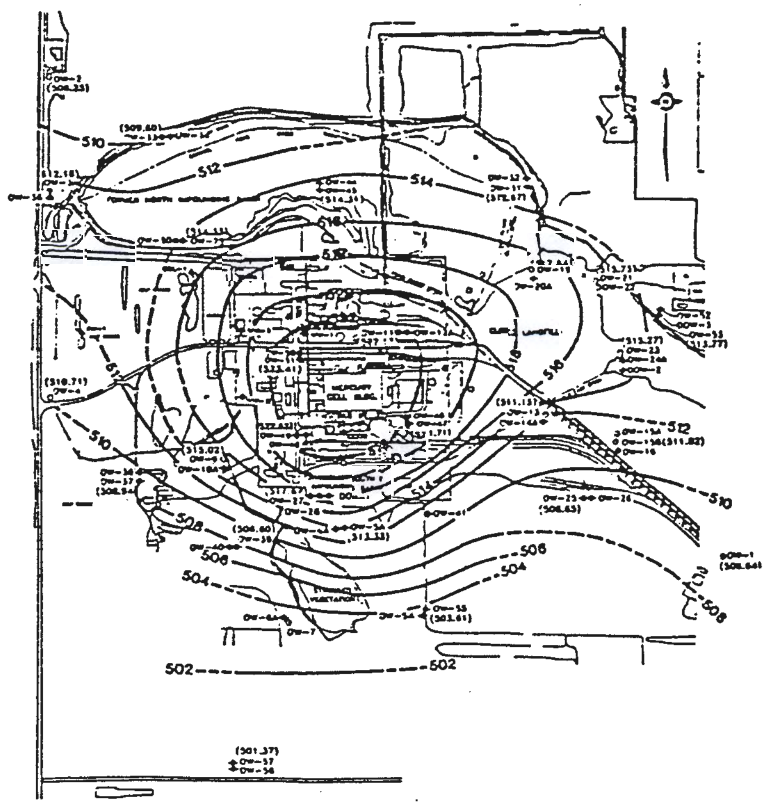
(Source: Reference 10)

Figure II-9

Upper Zone Potentiometric Surfaces



MAY 1989



OCTOBER 1990

DRAWN BY	N.S. NEFF 5-18-91	CHECKED BY / APPROVED BY	JCS 6/13/91	DRAWING NO.	87-0188

DATE	NO.	REVISION	BY

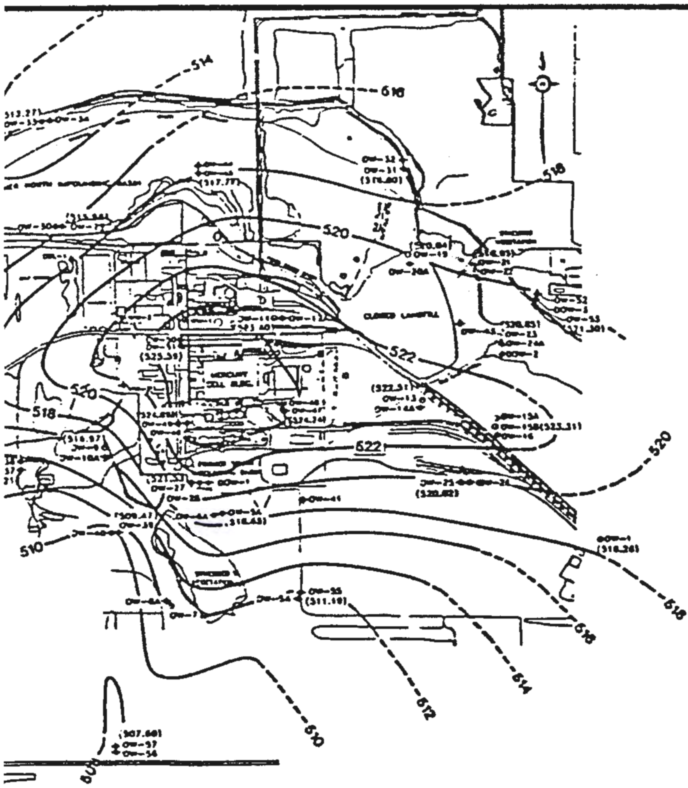
OCCIDENTAL CHEMICAL CORPORATIO

NIAGARA FALLS, NEW YORK

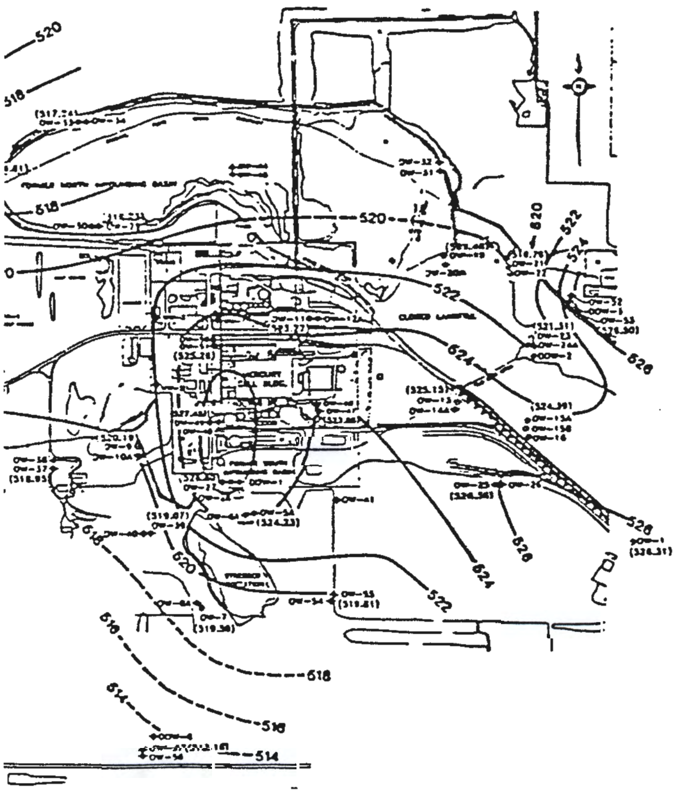
Client

F

Upper Zone P



SEPTEMBER 1989



MARCH 1991

LEGEND

(517.09) ELEVATION, FT., MSL

—520— POTENTIOMETRIC CONTOUR, FT., MSL

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

GROUNDWATER ASSESSMENT
MUSCLE SHOALS FACILITY
MUSCLE SHOALS, ALABAMA
Project Title

UPPER ZONE POTENTIOMETRIC SURFACES MAY 1989 - MARCH 1991

3-2
Fig. No.

e II-9
tiometric Surfaces (Source: Reference 1)

regolith, and from lateral flow through the karst solution channel network. Since the Upper and Lower Zones are in direct hydraulic communication, the hydrostatic forces on the two units are similar. As a result, the potentiometric levels from the Lower Zone also exhibit a groundwater mound underneath the facility process area, with a similar radial flow pattern. Figure II-10 exhibits the Lower Zone potentiometric surface for the period May 1989 to March 1991. Field derived hydraulic conductivity values for the Lower Zone range from 6.4×10^{-3} to 6.4×10^{-6} cm/sec, while the lateral hydraulic gradient ranges from 0.006 to 0.02 ft/ft. The calculated groundwater flow velocity in the Lower Zone ranges from 114 to 332 ft/year (Reference 10). In general, the vertical hydraulic gradient in both the Upper and Lower Zones is downward, however, upward gradients are not uncommon during periods of intense rainfall (Reference 10).

The Deep Zone is hydrologically distinct from the overlying Upper and Lower Zone in that the mechanics of groundwater flow is governed by the presence or absence of fractures and solution channels characteristic of karst environments. Fractures in the Tuscumbia Limestone tend to be oriented in a northwest to southeast direction. As a result, the solution channels are preferentially enlarged along this orientation. The hydrologic characteristics of the Deep Zone wells at the OxyChem facility depend on whether the wells were completed in the fractured zones. Deep Zone wells DOW-1, DOW-2, and DOW-3 were completed in dense, unfractured limestone. As a result, hydraulic conductivity values for these wells range from 8.2×10^{-7} cm/sec to 3.2×10^{-5} cm/sec (Reference 1). Well DOW-6 yielded a hydraulic conductivity value of 1.4×10^{-3} cm/sec, indicating that it was probably completed in a fractured zone. Wells DOW-2 and DOW-5 were most likely completed in solution channels, as field testing could not be accomplished due to the rapid recharge rates observed in the wells. In the latter case, groundwater movement occurs by conduit flow rather than by Darcian laminar flow. Potentiometric data collected from the Deep Zone wells indicates that the groundwater flow is to the west-southwest (Figure II-11). The groundwater mound characteristic of the Upper and Lower Zones is not present in the Deep Zone (Reference 1).

Occidental Chemical Corporation currently has 59 monitoring wells at the facility (References 1 and 10). The well locations are shown in Figures II-12 and II-13. These wells are screened across the Upper, Lower, and Deep Zones. There are 7 single well locations, 21 double cluster well locations containing a total of 43 wells (1 double cluster contains 3 wells, of which 2 wells are screened over the same interval), and 3 triple well cluster locations containing 9 wells. Twenty-nine wells monitor the Upper Zone, 24 monitor the Lower Zone, and 6 monitor the Deep Zone (References 1 and 10).

Figure II-10

Lower Zone Potentiometric Surfaces

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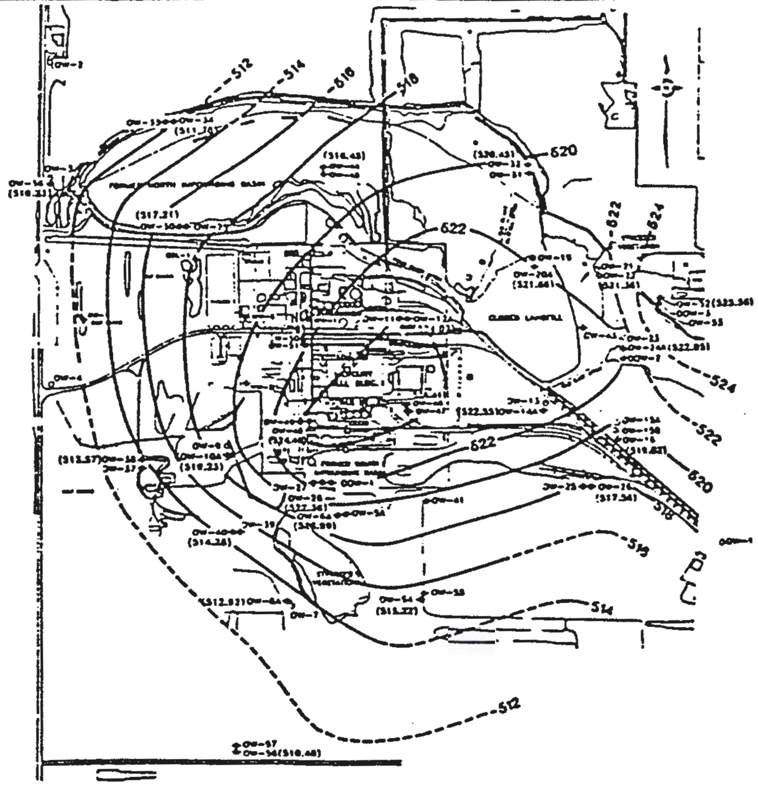
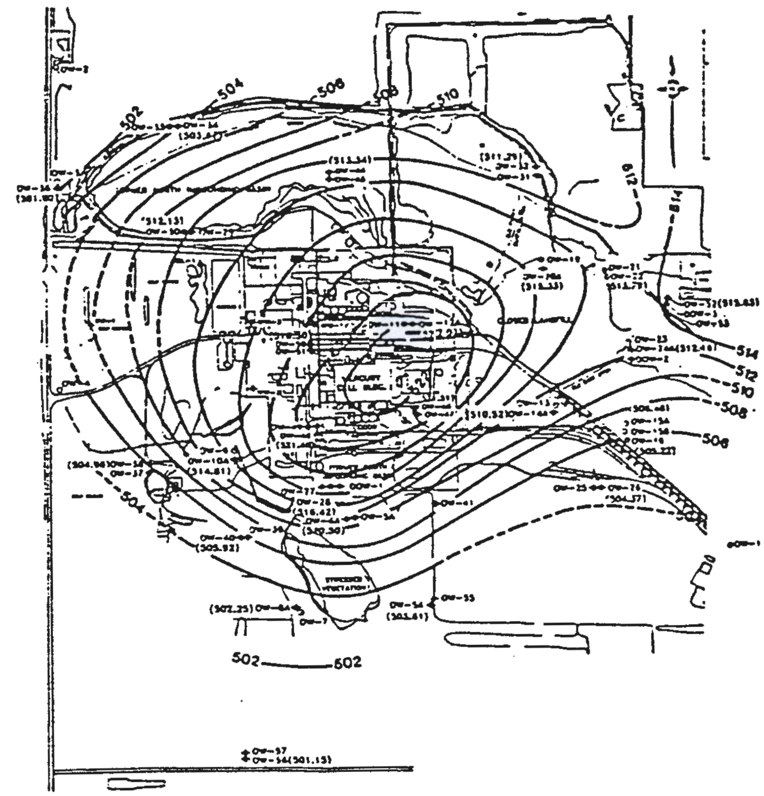
	5-18-91	APPROVED BY				



MAY 1989



OCTOBER 1990

DATE	NO.	REVISION	BY

OCCIDENTAL CHEMICAL CORPORATION
NIAGARA FALLS, NEW YORK
Client

Figure
Lower Zone Poter

Figure II-11

Deep Zone Potentiometric Surfaces

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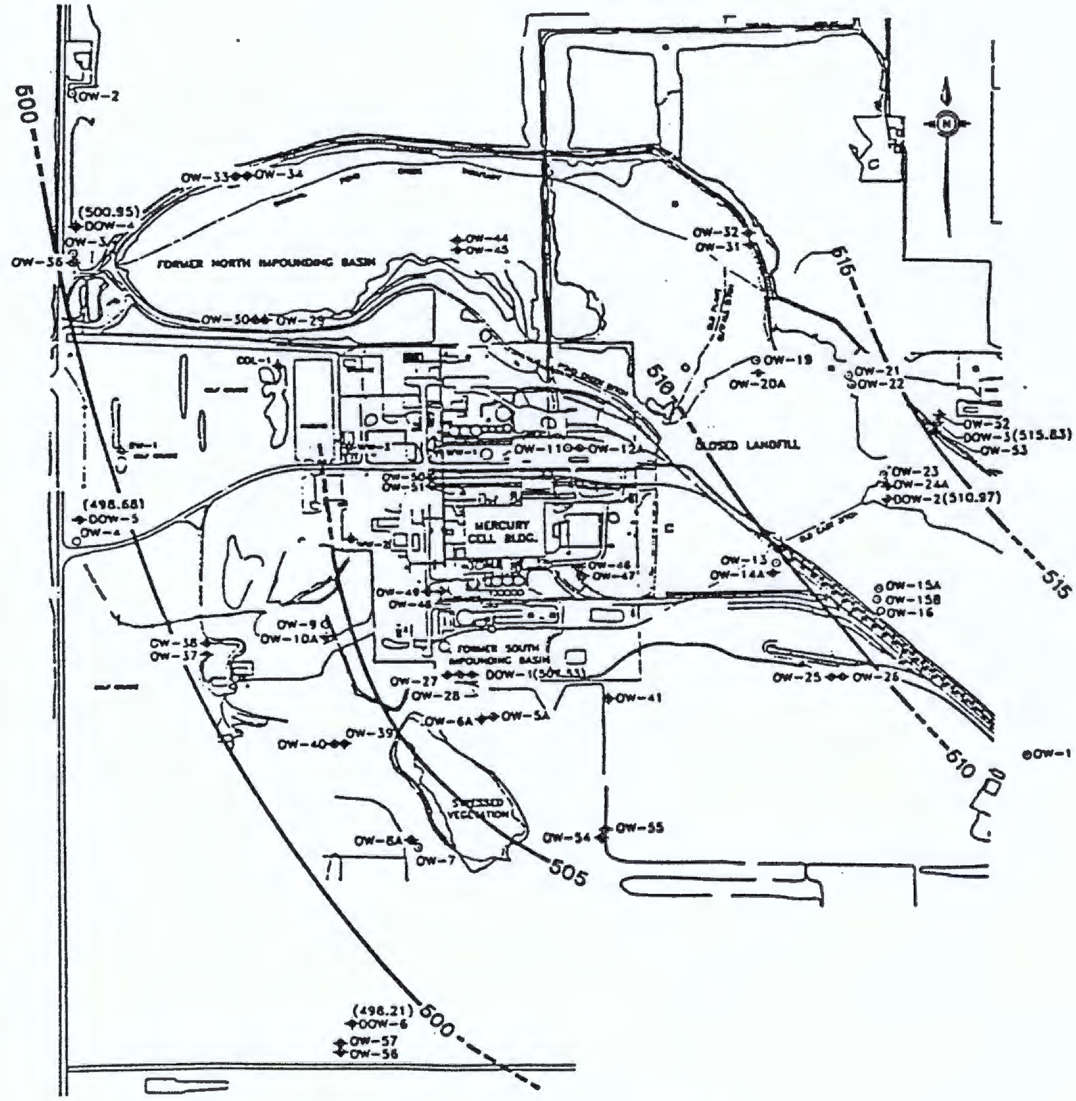
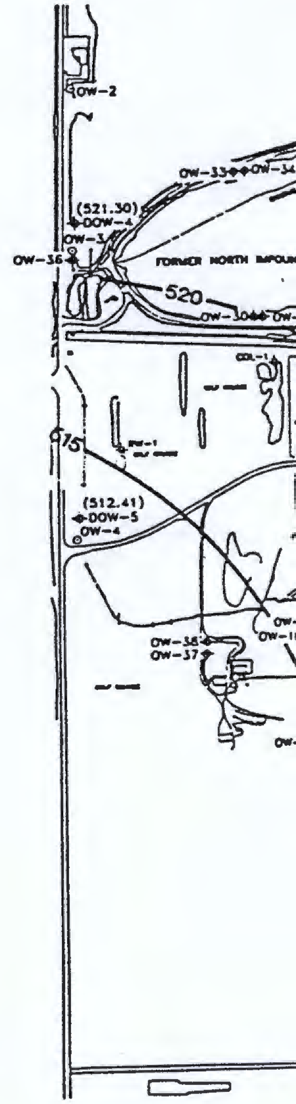


NOVEMBER 1990



DATE	NO.	REVISION	BY

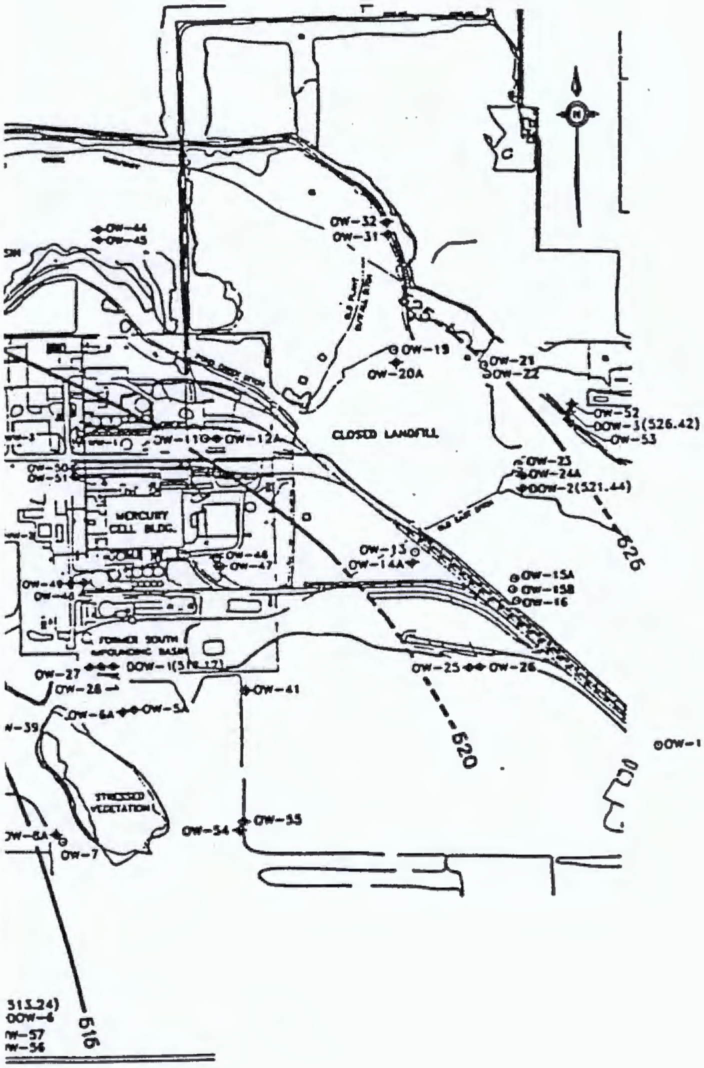
OCCIDENTAL CHEMICAL CORPORATION

NIAGARA FALLS, NEW YORK

Client

Figur

Deep Zone Poten



MARCH 1991

LEGEND

(517.09) ELEVATION, FT., MSL

—520— POTENTIOMETRIC CONTOUR, FT., MSL

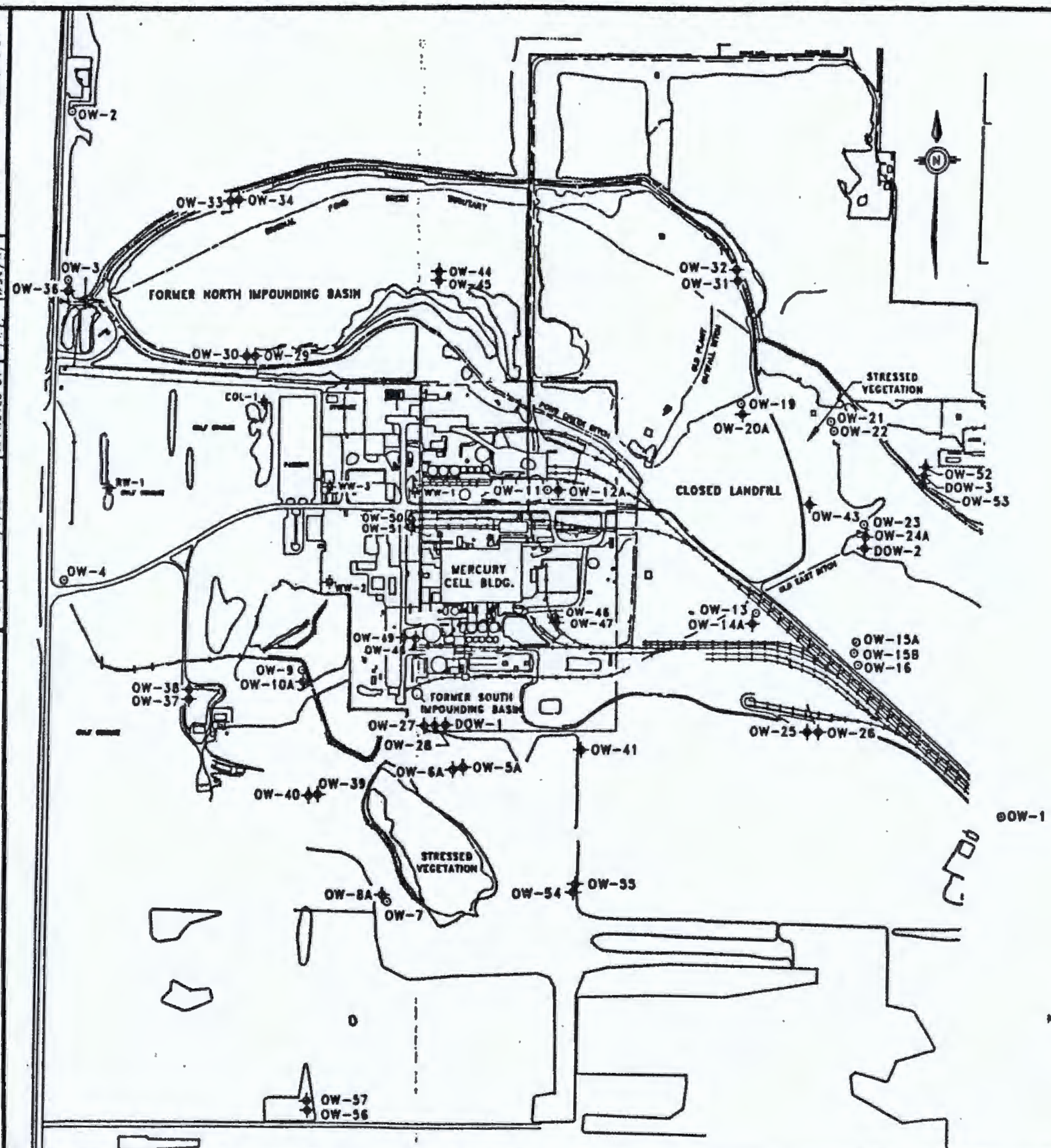
G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

GROUNDWATER ASSESSMENT MUSCLE SHOALS FACILITY MUSCLE SHOALS, ALABAMA Project Title	DEEP ZONE POTENTIOMETRIC SURFACES NOVEMBER 1990 - MARCH 1991	3-4 Fig. No.

-11
netric Surfaces (Source: Reference 1)

Figure II-12

Site Plan With Observation Well Locations



WELL I.D.	DATE INSTALLED	DEPTH (feet)	SURFACE ELEV. (ft. MSL)	TOP OF CASING ELEV. (ft. MSL)	SCREEN INTERVAL ELEV. (ft. MSL)
OW-1	9/80	38.00	531.71	534.93	495.04 - 485.04
OW-2	9/80	39.00	522.29	524.59	483.18 - 473.18
OW-3	9/80	38.00	519.23	521.80	483.89 - 473.89
OW-4	9/80	38.00	525.12	526.06	488.19 - 478.19
OW-5A	4/88	25.75	527.65	530.92	506.90 - 502.90
OW-6A	4/88	59.50	525.58	528.60	471.08 - 467.08
OW-7	1/81	31.50	521.98	525.39	496.70 - 491.70
OW-8A	3/88	73.08	527.01	523.10	453.93 - 449.93
OW-9	1/81	28.80	521.14	524.38	497.30 - 492.30
OW-10A	3/88	50.67	521.33	524.68	475.66 - 471.66
OW-11	1/81	24.90	527.52	527.09	507.40 - 502.40
OW-12A	3/88	52.91	527.36	527.22	479.45 - 475.45
OW-13	1/81	34.20	531.44	534.57	503.10 - 497.10
OW-14A	3/88	57.40	531.21	534.17	478.81 - 474.81
OW-15A	2/81	37.00	520.10	530.66	497.10 - 491.10
OW-15B	1/81	29.20	528.07	531.07	504.70 - 498.70
OW-16	2/81	51.50	528.25	531.40	479.25 - 488.85
OW-19	1/81	30.00	523.11	526.02	499.10 - 493.10
OW-20A	4/88	95.50	523.31	526.19	432.81 - 428.81
OW-21	2/81	15.20	519.82	523.32	510.80 - 504.80
OW-22	2/81	63.20	519.80	522.84	473.60 - 458.60
OW-23	1/81	14.50	520.80	524.50	512.20 - 506.20
OW-24A	4/88	73.75	521.76	524.78	453.01 - 449.01
OW-25	4/88	26.95	531.38	534.17	510.38 - 504.38
OW-26	4/88	61.50	531.41	534.47	475.24 - 471.24
OW-27	4/88	28.25	532.88	535.98	508.16 - 504.16
OW-28	4/88	63.75	532.37	533.72	473.82 - 469.82
OW-29	4/88	25.50	524.61	523.27	503.11 - 499.11
OW-30	4/88	51.75	523.46	522.49	476.71 - 472.71
OW-31	4/88	31.00	522.30	521.89	498.58 - 492.58
OW-32	4/88	81.00	522.42	521.99	448.42 - 442.42
OW-33	4/88	28.00	522.76	522.66	499.76 - 495.76
OW-34	4/88	58.50	522.80	522.53	471.30 - 467.30
OW-36	4/88	71.75	518.39	521.91	452.64 - 448.64
OW-37	7/88	30.33	524.78	524.54	499.45 - 495.45
OW-38	7/88	75.40	524.33	524.28	454.83 - 450.83
OW-39	7/88	30.33	521.21	524.08	495.88 - 490.88
OW-40	7/88	58.13	521.35	524.34	468.42 - 464.42
OW-41	7/88	51.00	540.09	543.26	494.09 - 490.09
OW-43	7/88	39.50	520.89	523.92	486.35 - 482.35
OW-44	8/88	52.00	521.94	524.68	474.94 - 470.94
OW-45	9/88	34.50	521.92	524.36	492.42 - 488.42
OW-46	10/88	57.50	527.80	530.22	475.30 - 471.30
OW-47	10/88	30.00	527.80	530.83	502.80 - 498.80
OW-48	10/88	55.00	528.37	528.23	478.57 - 474.57
OW-49	10/88	25.25	528.57	528.30	508.32 - 504.32
OW-50	10/88	63.50	528.64	531.00	470.14 - 466.14
OW-51	10/88	25.00	528.64	531.06	508.64 - 504.64
OW-52	12/88	78.00	523.85	528.24	452.85 - 448.85
OW-53	12/88	29.50	523.99	528.30	498.99 - 494.99
OW-54	12/88	63.00	525.77	529.06	467.77 - 463.77
OW-55	12/88	30.00	525.77	528.49	500.77 - 496.77
OW-56	12/88	74.00	524.25	526.65	455.25 - 451.25
OW-57	12/88	30.00	524.25	526.78	499.25 - 495.25
DOW-1	8/88	148.92	532.36	535.32	393.44 - 384.44
DOW-2	7/88	117.50	521.50	524.55	433.09 - 405.09
DOW-3	12/88	132.00	524.03	526.42	402.03 - 393.03

LEGEND

- EXISTING MONITORING WELL (UPGRADED)
- NEW MONITOR WELL
- WATER WELL (ABANDONED/CLOSED)

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS. WELL NOS. OW-17, OW-18, OW-35 AND OW-42 NOT USED.

0 feet 600
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

DATE	NO.	REVISION	BY	OCCIDENTAL CHEMICAL CORPORATION NIAGARA FALLS, NEW YORK Client	GROUNDWATER ASSESSMENT MUSCLE SHOALS FACILITY MUSCLE SHOALS, ALABAMA Project Title	SITE PLAN WITH OBSERVATION WELL LOCATIONS	2-2 Fig. No.

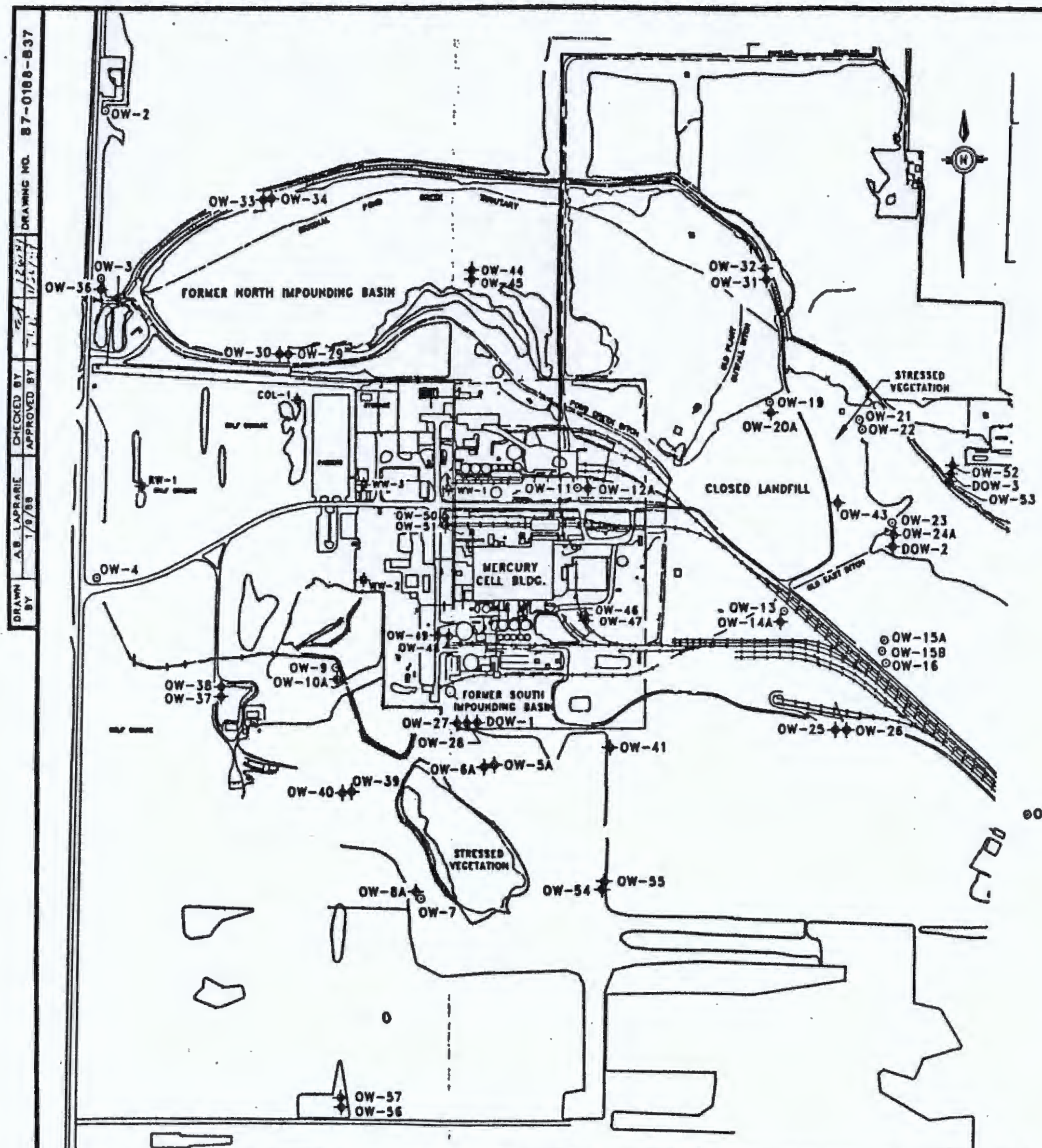
DRAWING NO. 87-0188-B37

Figure II–12
Site Plan With Observation Well Locations

(Source: Reference 10)

Figure II-13

Original Piezometer/OW-Well Locations



WELL I.D.	DATE INSTALLED	DEPTH (feet)	SURFACE ELEV. (ft. MSL)	TOP OF CASING ELEV. (ft. MSL)	SCREEN INTERVAL ELEV. (ft. MSL)
OW-1	9/80	38.00	533.71	534.83	493.04 - 485.04
OW-2	9/80	39.00	521.29	524.59	483.18 - 473.18
OW-3	9/80	38.00	519.23	521.80	483.89 - 473.89
OW-4	9/80	38.00	525.12	526.06	488.19 - 478.19
OW-5A	4/88	25.75	527.65	530.92	504.90 - 502.90
OW-6A	4/88	59.50	525.36	528.00	471.08 - 467.08
OW-7	1/81	31.50	521.98	525.39	496.70 - 491.70
OW-8A	3/88	73.08	527.01	529.10	453.93 - 449.93
OW-9	1/81	26.80	521.14	524.39	497.30 - 492.30
OW-10A	3/88	50.67	521.33	524.66	475.88 - 471.88
OW-11	1/81	24.80	527.52	527.09	507.40 - 502.40
OW-12A	3/88	52.91	527.38	527.22	479.43 - 475.45
OW-13	1/81	34.20	531.44	534.37	503.10 - 497.10
OW-14A	3/88	57.40	531.21	534.17	478.81 - 474.81
OW-15A	2/81	37.00	528.10	530.66	497.10 - 491.10
OW-15B	1/81	28.20	528.07	531.07	504.70 - 498.70
OW-16	2/81	51.50	528.25	531.40	478.35 - 468.85
OW-19	1/81	30.00	525.11	528.02	499.10 - 493.10
OW-20A	4/88	95.50	523.31	526.19	432.81 - 428.81
OW-21	2/81	15.20	519.82	523.52	510.60 - 504.60
OW-22	2/81	63.20	519.80	522.84	473.60 - 458.80
OW-23	1/81	14.50	520.80	524.50	512.20 - 508.20
OW-24A	4/88	73.75	521.78	524.78	453.01 - 449.01
OW-25	4/88	26.95	531.38	534.17	510.38 - 504.38
OW-26	4/88	61.50	531.41	534.47	475.24 - 471.24
OW-27	4/88	28.25	532.88	535.98	508.18 - 504.18
OW-28	4/88	63.75	532.57	535.72	473.82 - 469.82
OW-29	4/88	25.50	524.61	523.27	503.11 - 499.11
OW-30	4/88	51.75	523.46	522.48	476.71 - 472.71
OW-31	4/88	31.00	522.50	521.69	496.58 - 492.58
OW-32	4/88	81.00	522.42	521.99	448.42 - 442.42
OW-33	4/88	28.00	522.76	522.86	499.76 - 495.76
OW-34	4/88	56.50	522.80	522.53	471.30 - 467.30
OW-36	4/88	71.75	519.39	521.81	452.84 - 448.84
OW-37	7/88	30.33	524.78	524.34	499.45 - 495.45
OW-38	7/88	75.40	524.33	524.28	454.83 - 450.83
OW-39	7/88	30.33	521.21	524.08	495.88 - 490.88
OW-40	7/88	38.13	521.55	524.34	488.42 - 484.42
OW-41	7/88	81.00	540.09	543.28	494.09 - 490.09
OW-43	7/88	39.30	520.85	523.97	486.35 - 482.35
OW-44	9/88	52.00	521.94	524.66	474.94 - 470.94
OW-45	9/88	34.50	521.92	524.38	492.42 - 488.42
OW-46	10/88	57.50	527.80	530.22	475.30 - 471.30
OW-47	10/88	30.00	527.80	530.83	502.80 - 498.80
OW-48	10/88	55.00	528.57	528.23	478.57 - 474.57
OW-49	10/88	25.25	528.57	528.50	508.32 - 504.32
OW-50	10/88	63.50	528.64	531.00	470.14 - 466.14
OW-51	10/88	25.00	528.64	531.06	508.64 - 504.64
OW-52	12/88	78.00	523.85	526.24	452.85 - 448.85
OW-53	12/88	29.50	523.99	526.30	498.99 - 494.99
OW-54	12/88	63.00	525.77	528.06	467.77 - 463.77
OW-55	12/88	30.00	525.77	528.49	500.77 - 496.77
OW-56	12/88	74.00	524.25	526.65	455.25 - 451.25
OW-57	12/88	30.00	524.25	528.78	499.25 - 495.25
DOW-1	8/88	148.92	532.36	535.32	393.44 - 384.44
DOW-2	7/88	117.50	521.59	524.55	433.06 - 405.09
DOW-3	12/88	132.00	524.03	528.42	402.03 - 393.03

LEGEND

- EXISTING MONITORING WELL (UPGRADED)
- NEW MONITOR WELL
- WATER WELL (ABANDONED/CLOSED)

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS, EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS. WELL NOS. OW-17, OW-18, OW-35 AND OW-42 NOT USED.

0 feet 600
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS
Baton Rouge, Louisiana

DATE	NO.	REVISION	BY	OCCIDENTAL CHEMICAL CORPORATION NIAGARA FALLS, NEW YORK Client	GROUNDWATER ASSESSMENT MUSCLE SHOALS FACILITY MUSCLE SHOALS, ALABAMA Project Title	SITE PLAN WITH OBSERVATION WELL LOCATIONS	2-2 Fig. No.

Figure II–12
Site Plan With Observation Well Locations (Source: Reference 10)

Monitor wells and piezometers were installed at the facility beginning in 1980, subsequent to a request by ADEM that four monitor wells be installed around the landfill (Reference 45). By September 1980, 4 observation wells (OW-1 through OW-4) and 27 piezometers (P1 through P27) had been installed at the facility. Nineteen borings were advanced through the landfill cap in November 1980 to determine the permeability and geotechnical properties of the landfill cap materials. By March 1981, 21 additional observation wells (OW-5 through OW-24; including 2 wells at one location, OW-15A and OW-15B) had been installed at the plant site, bringing the total number of wells to 25. In 1988, 10 of the 25 wells were plugged and abandoned as a result of poor construction; however; 8 were re-drilled and completed as replacement wells. In addition, 34 soil borings were drilled at various locations across the facility property for soil characterization and laboratory analyses. Upon completion of the sampling activities, the borings were completed as Lower Zone monitor wells, bringing the total number of wells to 57. In addition to the wells, 21 of the 27 piezometers were abandoned. The six remaining piezometers were not abandoned because they either could not be located or were inaccessible. Five water supply wells are also present at the facility. Of these wells, one is closed, one is partially closed, two are inactive, and one is active only for purposes of water level measurement in the Deep aquifer. A detailed discussion of the current status and closure procedures of the water supply wells is presented in Reference 10.

In 1990, a supplemental hydrogeological study was conducted at the facility to better define the hydrogeologic relationship between the regolith and fractured limestone unit. Three additional monitor wells (DOW-4, DOW-5, and DOW-6) were installed to monitor the limestone Deep Zone. In addition, one Upper Zone monitor well (OW-43) was abandoned (Reference 1).

In October 1988, Occidental collected and analyzed two groundwater samples (OW-14A and OW-27) for 40 CFR 264 Appendix IX constituents. The analyses indicated the presence of mercury, cadmium, and chloride in concentrations exceeding the drinking water standards. In response, Occidental began submitting additional groundwater samples from locations across the facility for Appendix IX analyses. The results indicated that the groundwater underlying the facility was contaminated with mercury (Reference 10) (in concentrations ranging from <0.2 ppb to 340 ppb), cadmium (ranging from <5 ppb to 340 ppb), and chloride (ranging from <1 ppm to 170,000 ppm) (References 1 and 10). Figures II-14 through II-18 are isoconcentration contour maps which show the concentrations of the contaminants in the Upper and Lower Zones for the sampling period September 1989 to October 1990. In addition, Figure II-19 is an east to west geologic cross section which shows the vertical distribution of contaminants in

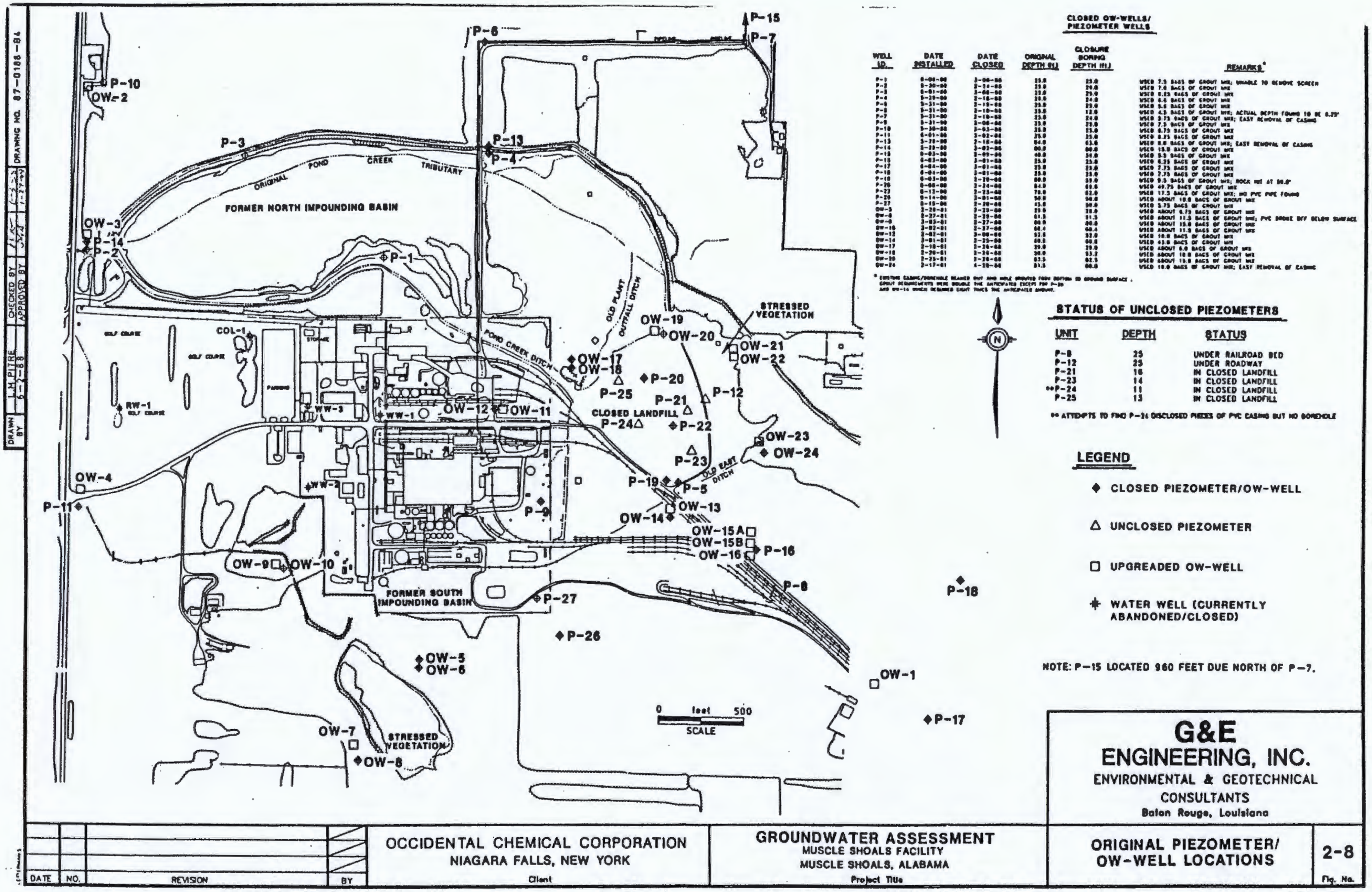


Figure II–13
Original Piezometer/OW–Well Locations

(Source: Reference 10)

Figure II-14

Upper Zone Mercury Concentration Isopleths

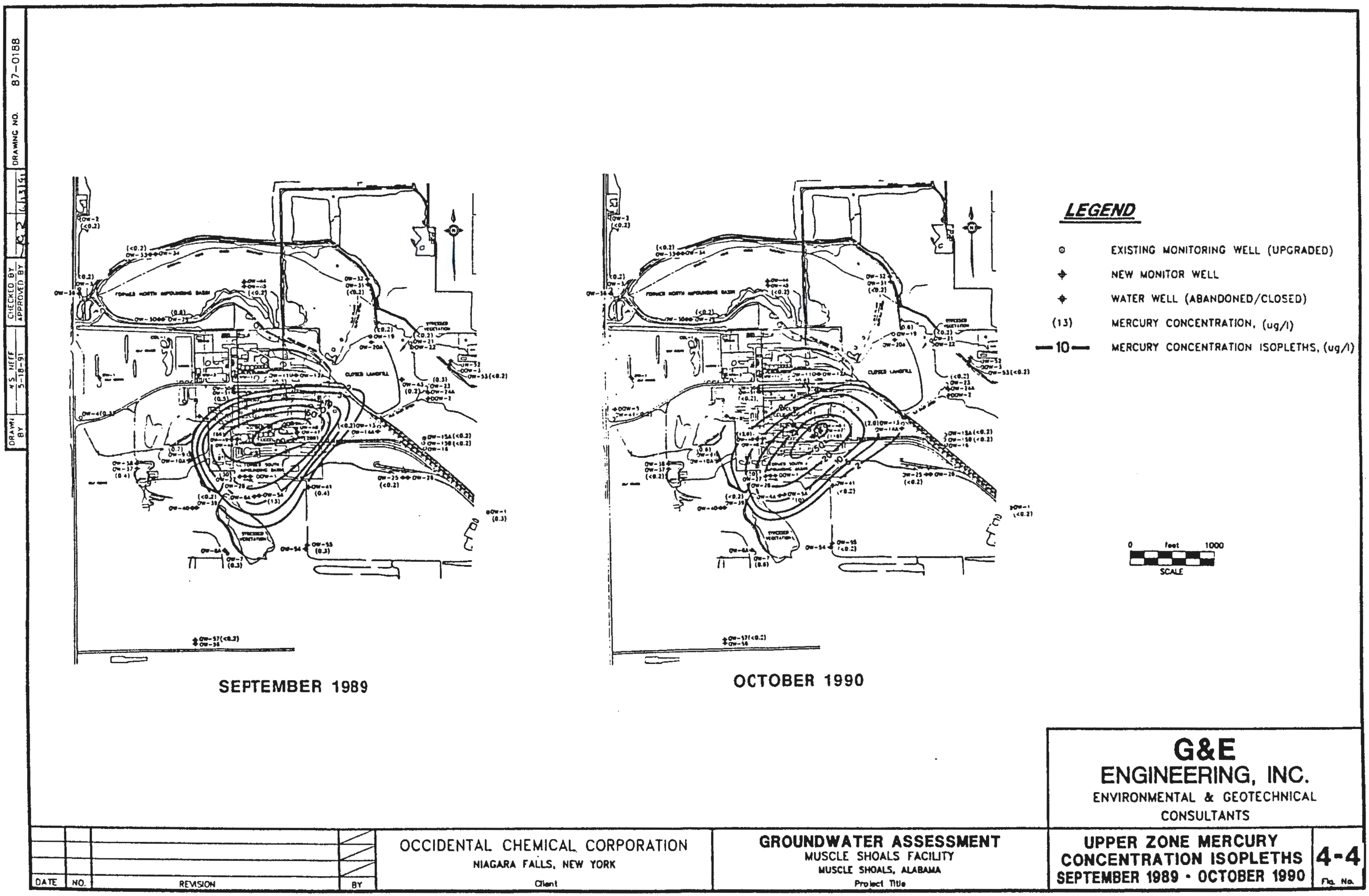


Figure II-14
Upper Zone Mercury Concentration Isopleths

(Source: Reference 1)

Figure II-15

Lower Zone Mercury Concentration Isopleths

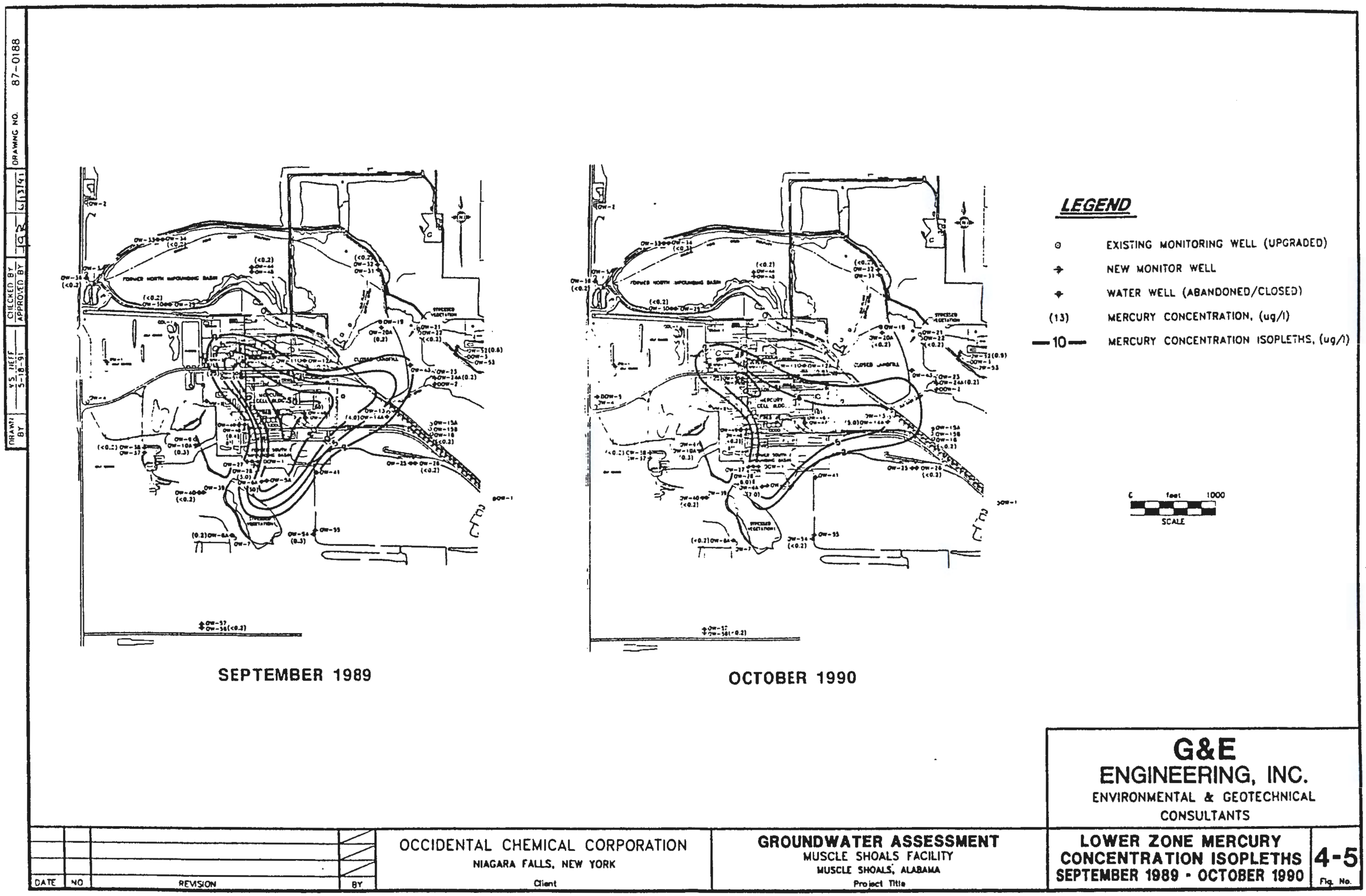


Figure II–15
Lower Zone Mercury Concentration Isopleths (Source: Reference 1)

Figure II-16

Upper Zone Chloride Concentration Isopleths

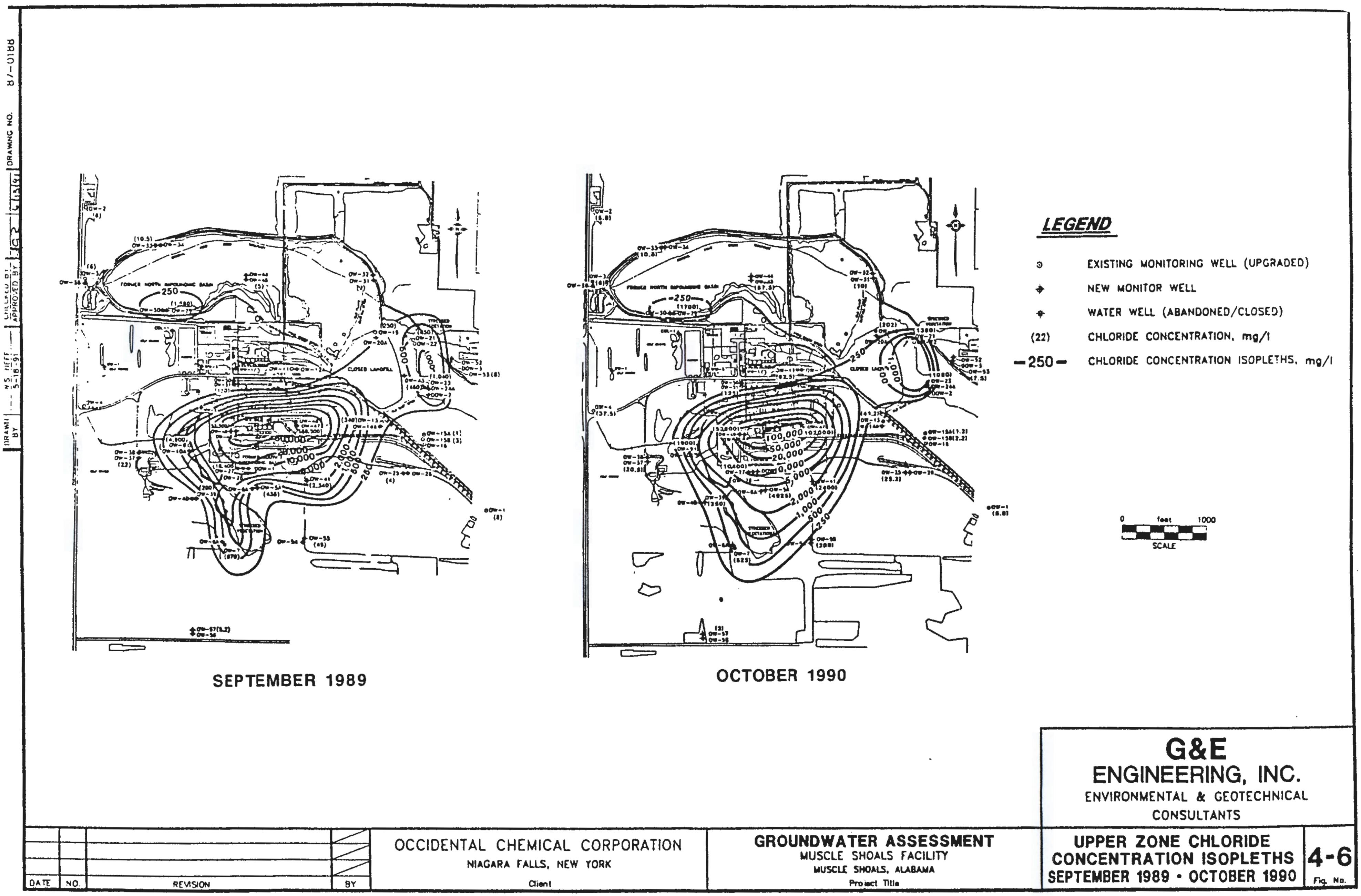
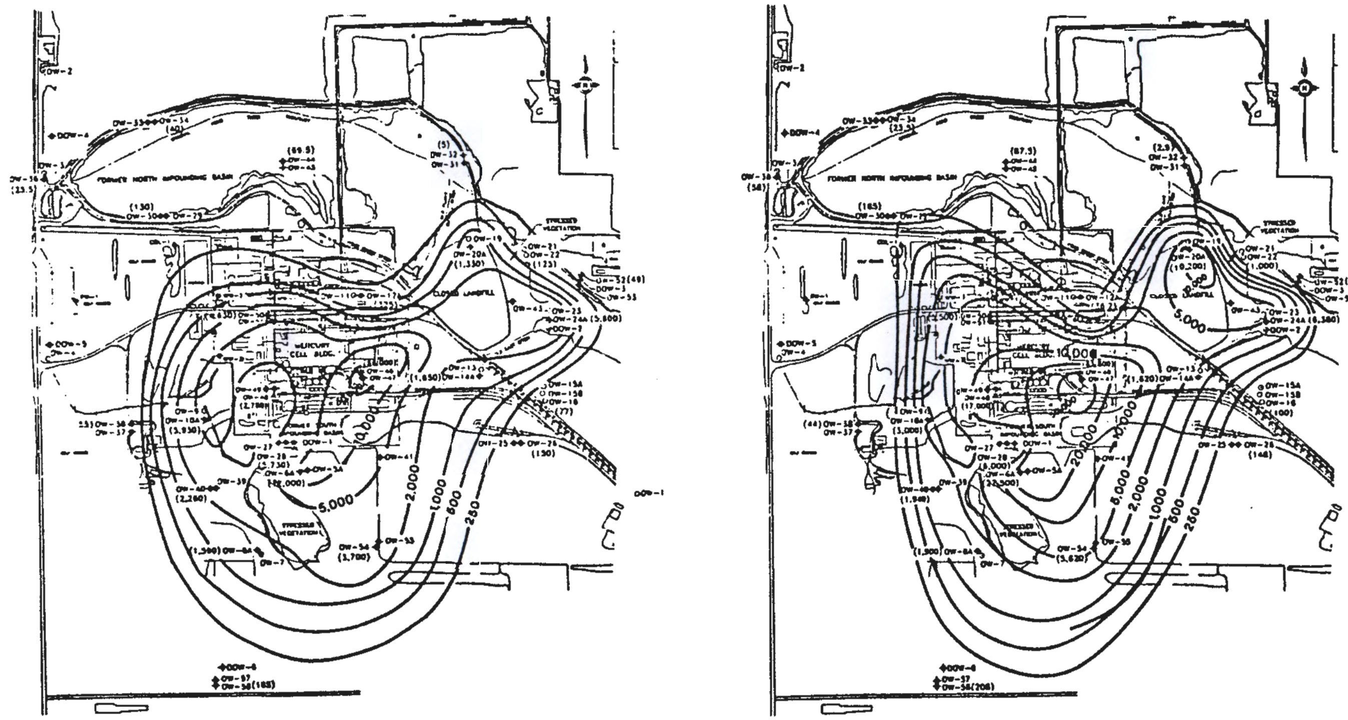


Figure II–16
Upper Zone Chloride Concentration Isopleths

(Source: Reference 1)

Figure II-17

Lower Zone Chloride Concentration Isopleths



SEPTEMBER 1989

OCTOBER 1990

LEGEND

⊙	EXISTING MONITORING WELL (UPGRADED)
✦	NEW MONITOR WELL
✦	WATER WELL (ABANDONED/CLOSED)
(22)	CHLORIDE CONCENTRATION, mg/l
—250—	CHLORIDE CONCENTRATION ISOPLETHS, mg/l

0 feet 1000
SCALE

DRAWN BY | 5-18-91 | CHECKED BY / APPROVED BY | DRAWING NO. 87-0188

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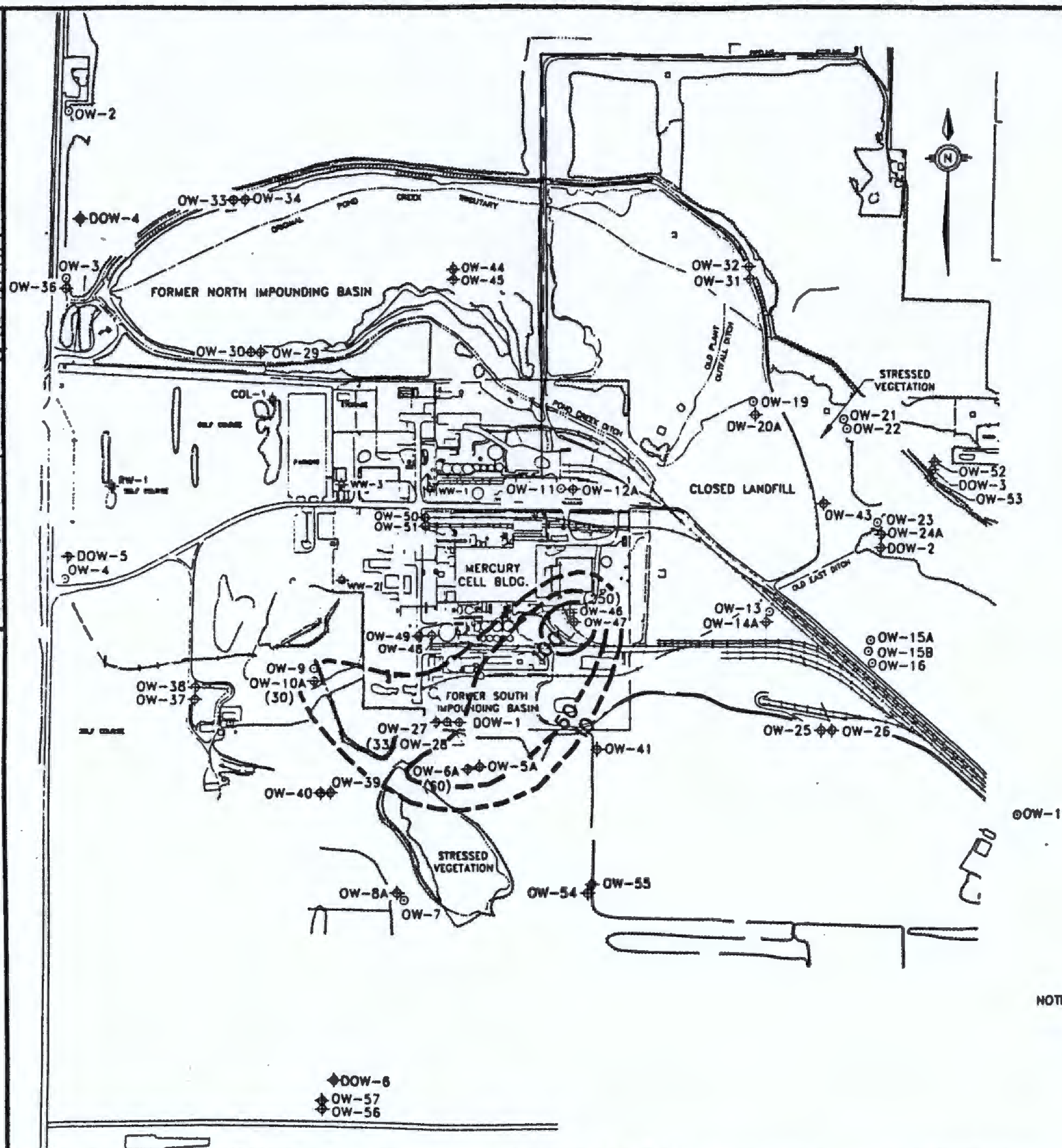
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

DATE	NO.	REVISION	BY	OCCIDENTAL CHEMICAL CORPORATION NIAGARA FALLS, NEW YORK Client	GROUNDWATER ASSESSMENT MUSCLE SHOALS FACILITY MUSCLE SHOALS, ALABAMA Project Title	LOWER ZONE CHLORIDE CONCENTRATION ISOPLETHS SEPTEMBER 1989 - OCTOBER 1990	4-7 Fig. No.

Figure II–17
Lower Zone Chloride Concentration Isopleths (Source: Reference 1)

Figure II-18

Cadmium Concentrations



CADMIUM GROUNDWATER ANALYSIS

	10/88-12/88 Cd (ug/l)	9/89 Cl mg/l	9/89 Cd (ug/l)	10/90-11/90 Cd (ug/l)
OW-5A	<5	4,380	<5	14•
OW-6A	80	12,000	60•	12•
OW-7	<5	870	<5	<5•
OW-8A	<5	1,590	<5	<5•
OW-9	<5	4,900	<5	<5•
OW-10A	30	5,930	30•	<5•
OW-11	<5	28	<5	<5•
OW-12A	<5	325	<5	<5•
OW-13	<5	340	<5	<5•
OW-14A	<5	1,650	<5	<5•
OW-19	<5	250	<5	<5•
OW-20A	NA	1,330	<5	11•
OW-21	<5	850	<5	<5•
OW-22	NA	125	<5	<5•
OW-23	<5	1,040	<5	<5•
OW-24A	<5	5,600	<5•	12•
OW-27	70	18,400	10•	11•
OW-28	100	5,730	33•	17•
OW-37	<5	22	<5	<5•
OW-38	<5	55	<5	<5•
OW-39	<5	200	<5	<5•
OW-40	<5	2,260	<5	<5•
OW-41	<5	2,340	<5	<5•
OW-46	330	66,000	250•	11•
OW-47	250	88,500	<5•	12•
OW-48	170	5,640	<5•	11•
OW-49	160	53,500	<5•	11•
OW-50	10	4,630	<5	14•
OW-51	<5	110	<5	<5•
OW-52	<5	48	<5	<5•
OW-53	<5	8	<5	<5•
DOW-1	<5	5,300	<5	<5•
DOW-2	30	25,500	30•	21•
DOW-3	<5	1,360	<5	<5•
DOW-4	-	-	-	<5•
DOW-5	-	-	-	5•
DOW-6	-	-	-	<5•

NA = Not Analyzed • Analyzed via chelation extraction

LEGEND

- ⊙ EXISTING MONITORING WELL (UPGRADED)
- ✦ NEW MONITOR WELL
- ✦ WATER WELL (ABANDONED/CLOSED)
- (30) CADMIUM CONCENTRATION, (ug/l)
- —10— CADMIUM CONCENTRATION CONTOUR, (ug/l)

NOTE: OW-2, OW-4 AND ODD NUMBERED WELLS ARE UPPER ZONE MONITOR UNITS. EVEN NUMBERED WELLS ARE LOWER ZONE MONITOR UNITS. WELL NOS. OW-17, OW-18, OW-35 AND OW-42 NOT USED.

0 feet 600
SCALE

G&E ENGINEERING, INC.
ENVIRONMENTAL & GEOTECHNICAL CONSULTANTS

DATE	NO.	REVISION	BY	OCCIDENTAL CHEMICAL CORPORATION, NIAGARA FALLS, NEW YORK (Client)	GROUNDWATER ASSESSMENT, MUSCLE SHOALS FACILITY, MUSCLE SHOALS, ALABAMA (Project Title)	CADMIUM CONCENTRATIONS	4-2 (Fig. No)

DRAWN BY: WS NEFF 3-18-91 | CHECKED BY / APPROVED BY: 12/13/91 | DRAWING NO. 87-0188

Figure II-18
Cadmium Concentrations

(Source: Reference 1)

Figure II-19

Vertical Cross Sections of Cadmium, Mercury, and Chlorine Groundwater Concentrations

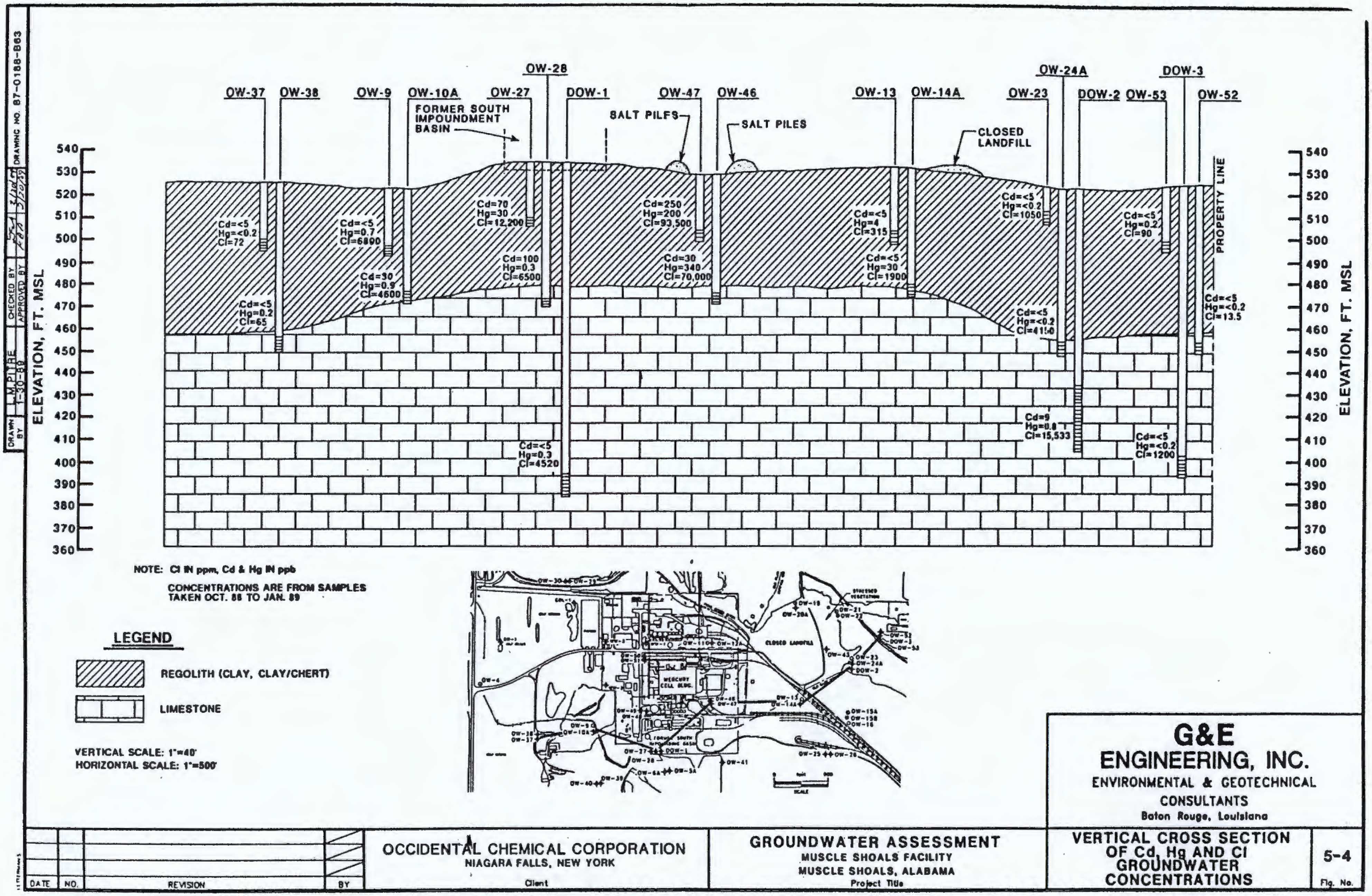


Figure II–19
Vertical Cross Sections of Cd, Hg, and Cl
Groundwater Concentrations

(Source: Reference 10)

the groundwater for selected wells for the sampling period October 1988 to January 1989 (Reference 1).

Figures II-14 through II-17 show that mercury and chloride contaminant plumes are present in the groundwater beneath the facility process area. With the exception of mercury in the Upper Zone, both plumes are bimodal; one plume is centered just south of the Mercury Cell Building while the second plume is centered directly underneath the Closed Landfill (SWMU 1). Prior investigations suggest that the configuration and expansion of the plumes are consistent with the groundwater flow regime at the facility. One slight deviation is the tendency for the mercury and chloride plumes in the Lower Zone to migrate towards the northwest. Previous studies have suggested that this plume deviation reflects a drawdown in the potentiometric surface as a result of pumping of the water supply wells to the northwest (Reference 10). The mercury plume is confined within the property boundaries of the Occidental Chemical plant. The chloride plume is confined within the facility property boundaries with the exception of the portion of the plume located east of the Closed Landfill (SWMU 1), where elevated concentrations may extend a limited distance offsite.

Figure II-18 shows the cadmium plume concentrations in the groundwater underneath the facility process area. The plume is believed to be centered just south of the Mercury Cell Building and in the immediate area of the former Salt Storage Piles (SWMU 4), and is totally confined within the property boundaries of the facility (Reference 1).

The major sources of contaminants to the groundwater and soil at the Occidental Chemical Corporation facility are believed to have been the Former Salt Storage Piles (SWMU 4), the Industrial Sewer (SWMU 14), Stressed Vegetation Area south of the plant (SWMU 24), Former North Impounding Basin (SWMU 3), the Former South Impounding Basin (SWMU 2), the unlined discharge ditches, the Mercury Cell Room Trench System (SWMU 7) and the Closed Landfill (SWMU 1). Other possible sources of contaminant release include gravel covered areas near plant operations (AOC C) where contaminated stormwater could have seeped into the ground.

A dye-tracing study was conducted of the groundwater flow regime within the Tuscumbia Limestone in the vicinity of the OxyChem Muscle Shoals facility. The dye was injected and flushed from deep observation wells. Passive dye detectors were utilized in the study (Reference 1). Study results indicated that the Deep Zone is hydraulically connected to Tuscumbia Springs, a municipal potable water supply located to the southwest. Groundwater flow velocities were found to range from 0.26 miles per day to 2.76 miles per day (Reference 1).

5. Receptors

Oxychem is located northeast of the city of Muscle Shoals, approximately one mile south of Wilson Dam on the Tennessee River. The area surrounding the facility is used for industrial, agricultural, and limited suburban and rural uses. The facility is accessed via Wilson Dam Road (State Highway 133) to the west, or a service road to the east. Industries located within two miles of the facility include the TVA National Fertilizer Development Center, the U.S. Diecasting plant (formerly Ford), and the Reynolds Aluminum plant (Reference 10).

Previous studies have indicated that there are 83 water wells located within a 3-mile radius of the facility. These wells are reportedly used for domestic, irrigation, and industrial purposes. Figure II-20 and Table II-1 shows the locations and lists the status of these wells. Most of the resident population receives water from the city of Muscle Shoals, which originates from the Tennessee River.

Potential surface water receptors located near the facility include Pond Creek (which is classified for Fish and Wildlife) and the Tennessee River (References 10, 41, 45 and 77).

The Karst geology in the area makes it extremely difficult to predict release pathways for contaminants that could impact receptors. One description of the karst features surrounding the facility indicated that "caves, springs, and the surface expressions of solution channels and sinks are abundant in the vicinity of the OxyChem facility" (Reference 1).

Figure II-20

Water Well Map

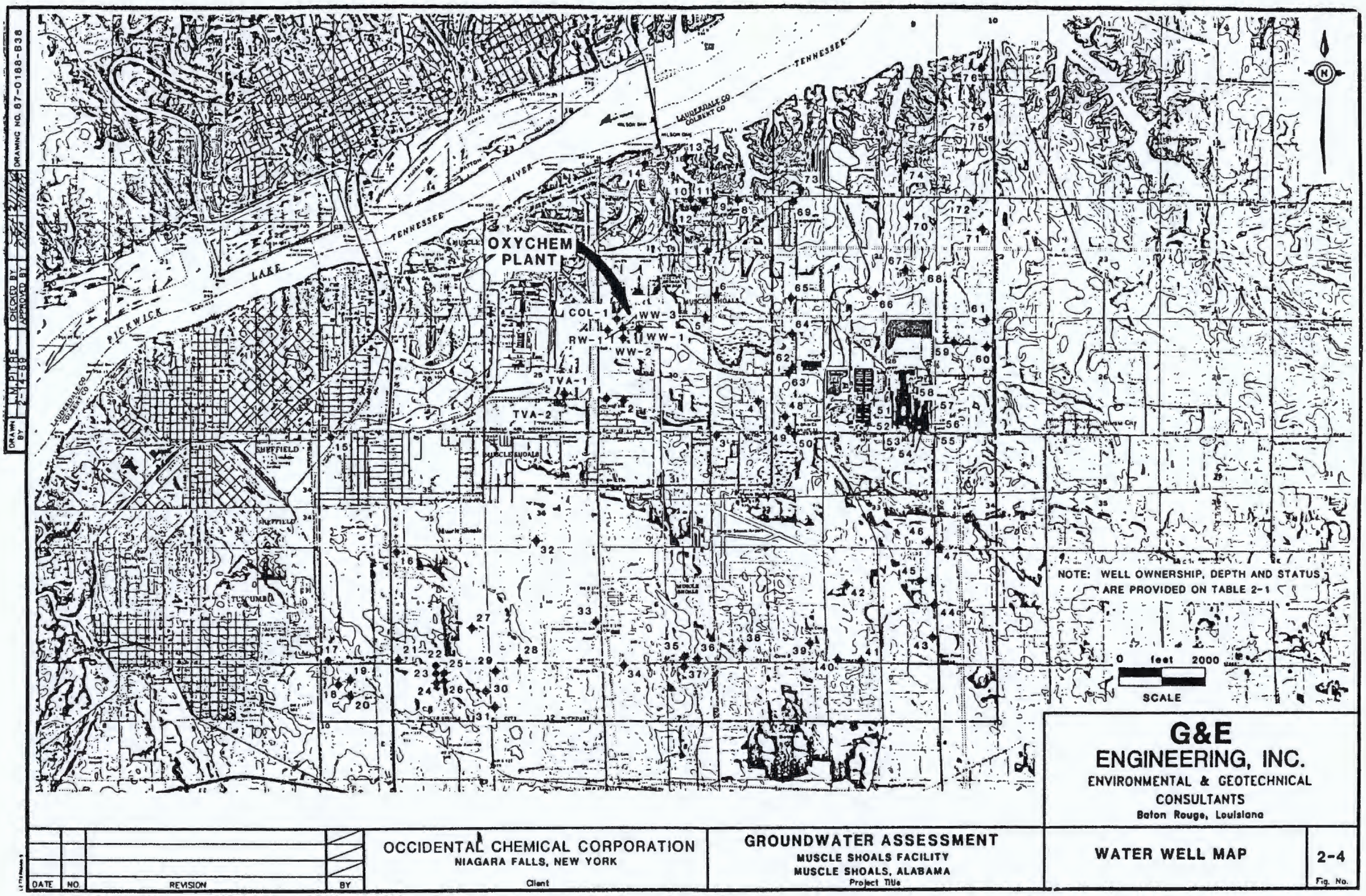


Figure II-20
Water Well Map

(Source: Reference 10)

TABLE 2-1
WATER WELLS IN VICINITY OF OXYCHEM
Sheet 1 of 2

Well Number	Depth (ft)	Use/Status*
WW-1	90	Closed
WW-2	87	Closed
WW-3	91	Closed
COL-1	257	USGS Survey Well
RW-1	87	Closed
TVA-1	62	Irrigation (Inactive)
TVA-2	80	Irrigation (Inactive)
1	Unknown	Domestic (Inactive)
2	75	Domestic (Inactive)
3	153	Industrial
4	74	Domestic
5	293	Domestic
6	85	Domestic
7	178	Public
8	62	Public
9	120	Domestic
10	330	Industrial (Inactive)
11	283	Industrial
12	164	Domestic
13	72	Domestic
14	Unknown	U.S. Gov. (Inactive)
15	90	Irrigation
16	165	Public
17	170	Industrial
18	181	Industrial (Inactive)
19	189	Industrial
20	91	Industrial
21	119	Industrial
22	102	Domestic
23	100	Domestic
24	Unknown	Domestic
25	111	Domestic
26	121	Domestic
27	104	Domestic
28	Unknown	Domestic
29	111	Domestic
30	82	Domestic
31	100	Domestic
32	45	Domestic
33	200	Public
34	130	Domestic (Inactive)
35	95	Domestic
36	70	Domestic
37	170	Domestic
38	118	Domestic
39	100	Domestic

III. SWMU DESCRIPTIONS

This section presents descriptions of the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) identified during the PR and VSI of OxyChem Muscle Shoals Chlor-Alkali Plant. The following abbreviations are used to designate release pathways:

L (Low):	Minimal potential for release
M (Medium):	Moderate potential for release
H (High):	Evidence suggests that release(s) has (have) occurred
U (Unknown):	No information is available

SWMU NUMBER: 1 **PHOTOGRAPH NO.** 1.1-1.5

NAME: Landfill

TYPE OF UNIT: Landfill

PERIOD OF OPERATION: 1955 to February 1980

PHYSICAL DESCRIPTION AND CONDITION: The unit was an open unlined area used for deposition of waste generated at the facility over a 25-year period ending in 1980. The landfill is located approximately 1,000 feet northeast of the Mercury Cell Building and was constructed over a native reddish brown clay. As part of the closure activities in 1979, the landfill surface was covered with a clay soil. A 1990 report (Reference 3) indicated that the thickness of waste materials and depth to waste in the landfill were highly variable. The thickness of waste materials ranged from 2 feet to greater than 12 feet and the depth to waste ranged from 2 feet below the surface to greater than 8 feet. Waste materials were found to be present at depths greater than 14 feet below the surface in several locations. However, since that evaluation was conducted, there have been additional modifications to the cover system (Reference 1).

A geotechnical evaluation conducted in November 1980 found that the landfill was covered with a clay layer from 1.7 feet to 10.2 feet thick. The study indicated that the cover material was devoid of vegetation and that there were horizontal bedding planes within the clay cover material. Permeability tests conducted on the clay cover gave values substantially in excess of 1×10^{-7} centimeters per second (cm/s). The landfill cover was to be reworked to provide a minimum thickness of 3 feet and to give the cover a maximum permeability of 1×10^{-7} cm/s (Reference 7). However, no records have been identified to indicate whether the proposed cover upgrading actually occurred.

A 1987 study indicated the following:

- the cover had a number of depressions which were holding water;
- the surface was soft, wet, and had a number of ruts caused by tractors used for mowing
- the landfill vegetation was spotty with some areas having little or no grass;
- two power poles penetrated the cap

- a small berm, constructed around the landfill to prevent runoff from eroding the sidewalls of the landfill, was causing excess standing water near the edges of the landfill;
- a major erosion feature was noted on the northwest portion of the landfill;
- water was standing in the area adjacent to the north side of the landfill.

Between 1987 and 1989, the landfill was further assessed and the following findings were made:

- depressions in the cover were resulting in standing water and increased infiltration;
- the vegetative cover was one that did not provide total coverage;
- leachate from the landfill appeared to be associated with stressed vegetation in low areas to the south and east of the landfill;
- there was concern about cover integrity in the areas where piezometers had been installed and subsequently covered up.

In 1990, the following actions were taken to upgrade the landfill:

- topsoil and vegetation was scraped off the old landfill surface;
- the areas of stressed vegetation east of the landfill were excavated and deposited over the old landfill surface;
- the old landfill surface was then reconfigured to promote lateral runoff of rainfall by cutting into the cover in some areas and by adding either this cut material or new borrow material to other areas;
- a 30-mil geomembrane was placed over the old landfill surface and the area to the immediate east of the old landfill where the stressed vegetation had been excavated;
- a geotextile was placed over the geomembrane and one foot of topsoil was placed over the geotextile.

Photographs 1.1 and 1.2 (see Appendix B) show an asphalt lined perimeter ditch that extends along the southwestern side of the landfill. Close inspection of the ditch revealed several areas where the earth beneath the ditch had subsided to such an extent that the asphalt liner had broken up.

Photograph 1.3 (see Appendix B) shows the area along the northeastern side of the old landfill where there had been stressed vegetation. The polyvinyl chloride (PVC) pipes are indicators for the edge of the geomembrane cover that is under the surface. As can be seen in the photograph, there are minor areas adjacent to one of the PVC markers that were bare. While there was a good vegetative cover over most of the landfill (see Photograph 1.4, Appendix B), there were bare areas (Photograph 1.5 and 1.6) and evidence of animal and ant activity (Photograph 1.7 and 1.8). This animal activity may be significant because the cover incorporates a relatively thin geomembrane (30-mil PVC), and the soil covering over this geomembrane is only one foot thick.

Photographs 1.9 through 1.12 (see Appendix B) show the panoramic view at the base of the landfill looking initially to the northeast and panning to the northwest (in the direction of the Former North Impounding Basin, SWMU 3). Several areas were observed to be bare of vegetation, and there appeared to be dead trees on the perimeter of the forested area to the north and northeast of the landfill at the time of the VSI.

The landfill was revisited following a precipitation event and several areas of standing water were noted on the landfill surface (Photographs 1.13 through 1.15, see Appendix B). These areas appeared to be associated with low spots and areas of sparse vegetation in the cover.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The landfill received plant debris, NaCl and KCl brine sludges, sump sludge and filter material, saturator precipitates, filter carbon and other materials that were contaminated with mercury. Plant personnel could not recall how PCB waste were disposed prior to 1980, and consequently, it is possible that this waste was also disposed in the landfill. The unit reportedly contains 90,000 tons of brine mud (33,000 tons of clarifier backwash mud, 57,000 tons of saturator sludge, and another 2,500 tons of retorted sump sludge and filter material).

RELEASE PATHWAYS: Air (U)* Surface Water (H) Soil (H) Groundwater (H) Subsurface Gas (U)*

HISTORY AND/OR EVIDENCE OF RELEASE(S): The landfill has been implicated as a contributor to contamination of soil, surface water and groundwater with cadmium, mercury and chloride. This supposition has been substantiated by data from several monitoring wells, surface water samples and soil samples. In addition, during a May 1988 sampling event, seepage was observed from the berm along the eastern portion of the landfill. Analysis revealed mercury, cadmium and chloride values as high as 120 milligrams per liter (mg/l), 0.7 mg/l and 42,000 mg/l, respectively. Figures II-14 through II-18 (beginning on page II-31) show the plumes of mercury, cadmium and chlorides associated with the landfill.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCES: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 25

COMMENTS: While this unit has received upgrades, there was some visual evidence that soil adjacent to and to the north of the unit may still be affected by landfilled constituents (i.e., bare soil and dead trees). The cover was said to have been recontoured to promote runoff, but at the time of the VSI there was visual evidence of areas on the cover that are poorly drained. This may be evidence that the cover is subsiding. Sections of the asphalt lined perimeter ditch showed definite signs of subsidence of the underlying soil. As part of the RFI, an evaluation should be made of the vertical and lateral extent of migration of contaminants from the landfill. An assessment is also needed to determine if any cover system can effectively prevent further contamination in the absence of a liner system.

If subsidence is occurring or if animal activity continues in the cover, premature and rapid deterioration of the geomembrane could occur quickly. Since the bedding layer under the geomembrane was contoured by cutting and filling the existing clay cover, there may now be a thinner veneer of clay in places than prior to the last landfill upgrade. Consequently, when the geomembrane deteriorates, the situation at the landfill may be even less favorable than before the last upgrade in the cover.

At a minimum, there should be 1) periodic detailed surveys of the landfill surface to monitor for degree of subsidence; 2) sampling of the bare areas on and adjacent to the landfill; and 3) an investigation to determine what is killing the trees north of the landfill. In addition, measures should be taken to minimize animal activity in the cover and determine the depth and effect of past incursions.

There should also be an effort made to monitor the leachate depth in the landfill. This information will indicate how effective the cover is at minimizing infiltration and could serve as an indicator of cover failure if the level changes.

There was no available information in the facility records or from discussions with facility personnel concerning the management of PCB wastes prior to 1980. It is considered possible that much of this waste was disposed in the onsite landfill that was operating at that time. Consequently, analytical studies conducted on samples of leachate, landfilled waste, groundwater, soils, seeps, dead vegetation, sediments and surface water should include PCB analysis. In addition, any remedial actions considered for the landfill area should incorporate the potential presence of PCBs.

* The release potentials for the air and subsurface gas pathways were listed as unknown because no information was available on the potential for mercury vapors to migrate from the landfill.

SWMU NUMBER: 2 **PHOTOGRAPH NO.:** 2.1-2.4

NAME: Former South Impounding Basin

TYPE OF UNIT: Landfill/Former Surface Impoundment

PERIOD OF OPERATION: 1970-1976

PHYSICAL DESCRIPTION AND CONDITION: This unit was a rectangular unlined surface impoundment (measuring 200 feet by 300 feet) which received approximately 2,000 gallons per day of untreated wastewaters that flowed from the Mercury Cell Room Trench System (SWMU 7). The impoundment was originally used for treatment of the wastewater (by adding sodium bisulfide to precipitate mercury) which was to be released to the Industrial Sewer System (SWMU 14). A significant seepage loss from the impoundment, however, made it unnecessary to do this very often.

Although this seepage eventually raised the concern of mercury migration, the results of a column leaching test (performed by Diamond on the soil from the area of the impoundment) concluded that the mercury would be adsorbed by the soil. No written record of the leaching test could be located by plant personnel at the time of the VSI.

A 1987 geophysical conductivity survey showed elevated conductivity values in the area of the former impoundment and in an adjacent area of stressed vegetation. Conductivity values were highest in the immediate vicinity of the former impoundment and decreased with distance from both the boundary of the former impoundment and the stressed vegetation area. These elevated values continued throughout the depths evaluated in the survey (40 meters).

Borings adjacent to the former impoundment showed very high levels of mercury ranging from 200,000 micrograms per kilogram ($\mu g/kg$) to 2,600 $\mu g/kg$ at a depth of 5 to 15 feet. Another boring 200 feet south and downhill from the former impoundment also contained elevated mercury concentrations (90 $\mu g/kg$ to 1,300 $\mu g/kg$ to a depth of 10 feet, and 260 $\mu g/kg$ and 100 $\mu g/kg$ at depths of 40 and 50 feet, respectively). There were also high values for chlorides associated with the elevated mercury values. Mercury, cadmium and chlorides were also found in groundwater samples adjacent to the former impoundment between 1987 and 1990.

Plant personnel stated that the impoundment was taken out of service in 1980 by bulldozing inward the abovegrade berms that surrounded the unit. Apparently all the waste solids and precipitated mercury were left in place. It is not known how thick the residual waste layer is in the former impoundment, but the borings and groundwater monitoring in the area indicate that this material is continuing to release hazardous constituents to the adjacent soil, surface water and groundwater. Photographs of the surface of the former impoundment show bare areas (see Photograph 2.1, Appendix B), standing water (see Photograph 2.2, Appendix B), an uneven surface that appears to be undergoing differential subsidence (see Photograph 2.3, Appendix B), and areas where water apparently had pooled and then seeped into the surface (see Photograph 2.4, Appendix B).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: From 1970 to 1974, approximately 2,000 gallons per day of wastewater from the Mercury Cell Room Trench System (SWMU 7) were treated in the impoundment. From 1974 to 1976, the impoundment held excess wastewater flow until it could be treated in the wastewater treatment facility. The impoundment was replaced by the Hypalon Storage Tank (SWMU 8) in 1976. Primary constituents managed in the unit were mercury, cadmium, and chlorides.

RELEASE PATHWAYS: Air (U)* Surface Water (H) Soil (H)
Groundwater (H) Subsurface Gas (U)*

HISTORY AND/OR EVIDENCE OF RELEASE(S): Definitive evidence has been presented showing that the former impoundment is a continuing source for the release of hazardous constituents to the surrounding soil, surface water and groundwater. Figures II-14 through II-18 (beginning on page II-31) show the plumes of mercury, cadmium and chlorides associated with the basin.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 1, 10, 18

COMMENTS: The unit is in effect a hazardous waste landfill without a liner or effective cover. Consequently, this unit may be a substantial continuing source of hazardous constituent releases to the environment. A rapid assessment of this unit is suggested to determine the advisability of interim measures. As part of the RFI, a detailed assessment should be made of the extent and magnitude of contaminant migration beneath and adjacent to the unit.

* The release potentials for air and subsurface gas pathways were listed as unknown because there was no information available on the potential for mercury vapors to migrate from the unit.

SWMU NUMBER: 3 **PHOTOGRAPH NO.:** 3.1-3.2

NAME: Former North Impounding Basin

TYPE OF UNIT: Former Surface Impoundment

PERIOD OF OPERATION: 1970-1971

PHYSICAL DESCRIPTION AND CONDITION: This unlined former surface impoundment is located north of all plant process areas stretching from the northwest end of the Landfill (SWMU 1) to Wilson Dam Road. The basin was formed in 1970 by damming the western end of Pond Creek Tributary to form an unlined surface impoundment formerly used to control the rate of wastewater discharges to Pond Creek. Also included in the basin area is the old plant outfall ditch (or original pond creek tributary which runs from east to west in the northeast corner of the basin. This ditch was operational from 1953 to 1971 and received 8,000 to 12,000 gallons per minute (gpm) of wastewater, of which approximately 100 gpm was Mercury Cell Building wastewater.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The unit was used from 1970 to 1971 to impound approximately 5,000 gpm of Mercury Cell Building wastewaters, runoff water and noncontact wastewaters. The impounded liquids were treated with sodium bisulfide to precipitate mercury prior to discharge. In one area of the basin just north of the Junkyard (AOC A), there were piles of excavated soil (from elsewhere on the facility) and construction debris at the time of the VSI.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (M) Groundwater (M) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): A geophysical survey found evidence of subsurface contamination with "ionic mobility constituents" under both the western and eastern ends of the Former North Impounding Basin, SWMU 3, (see Figures III-1 through III-5). It should be noted that the indication of subsurface contamination extended to the edge of the area surveyed, indicating that the plume may extend well beyond the edge of the basin, especially to the north and northeast of the former basin. It should also be noted that the highest readings in the former basin seem to be associated primarily with the path of the former old plant outfall ditch.

There is also evidence of groundwater chloride contamination in the western end of the impoundment (detected in observation wells

Figure III-1

Geophysical Survey Grid System

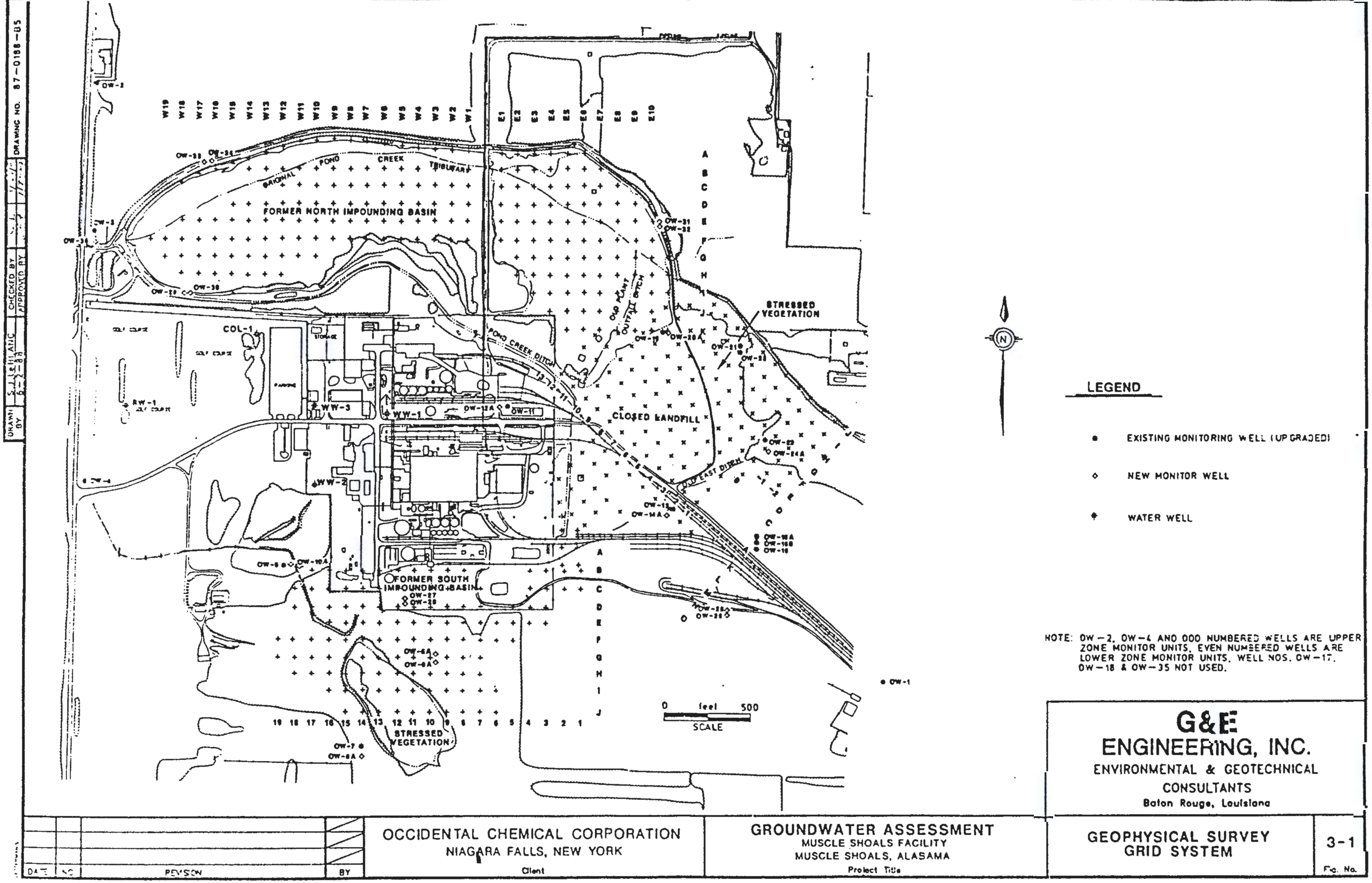


Figure III–1
Geophysical Survey Grid System

(Source: Reference 10)

Figure III-2

Geophysical Survey 6 Meter Depth

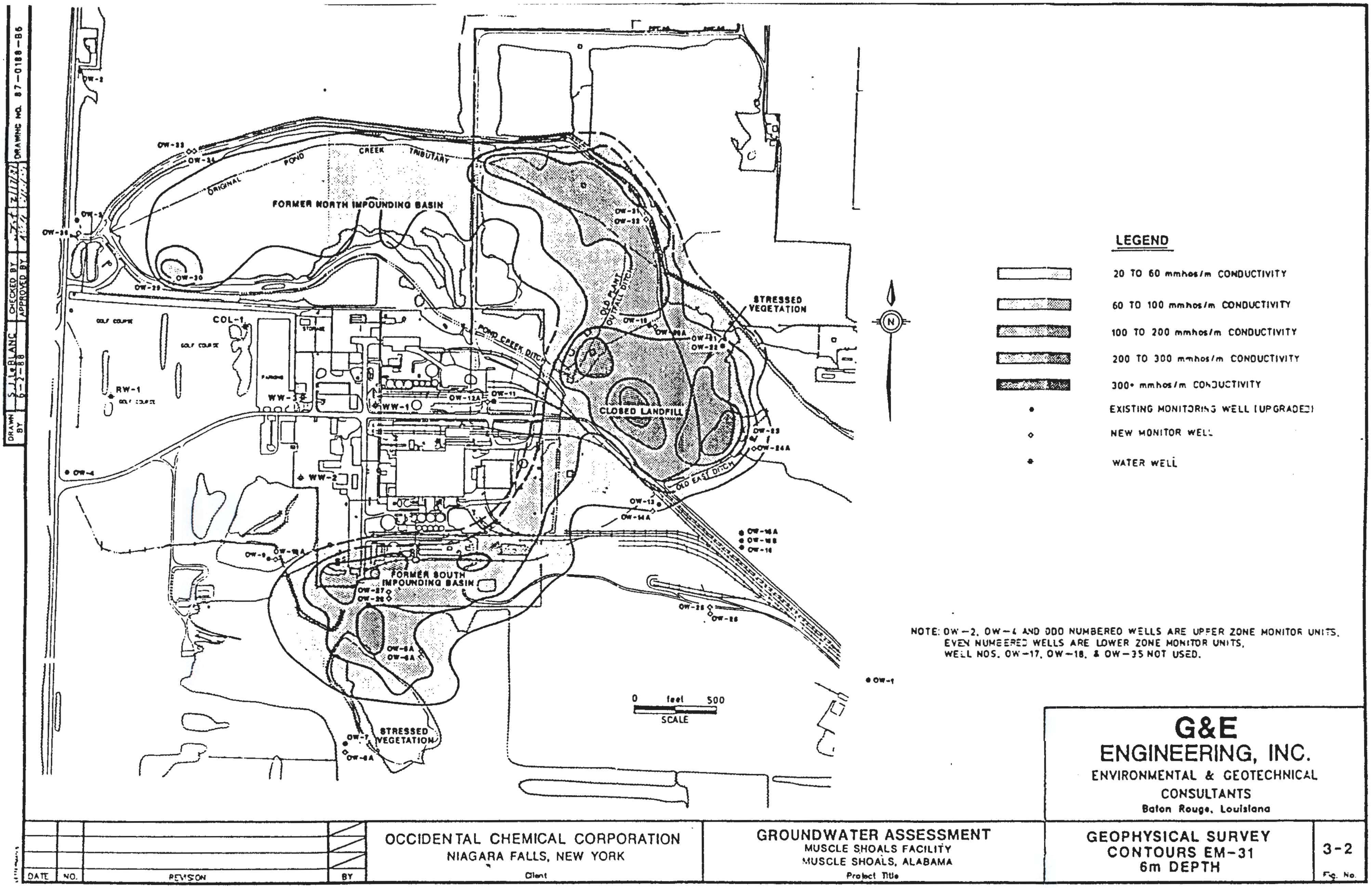


Figure III-2
Geophysical Survey 6m Depth

(Source: Reference 10)

Figure III-3

Geophysical Survey 10 Meter Depth

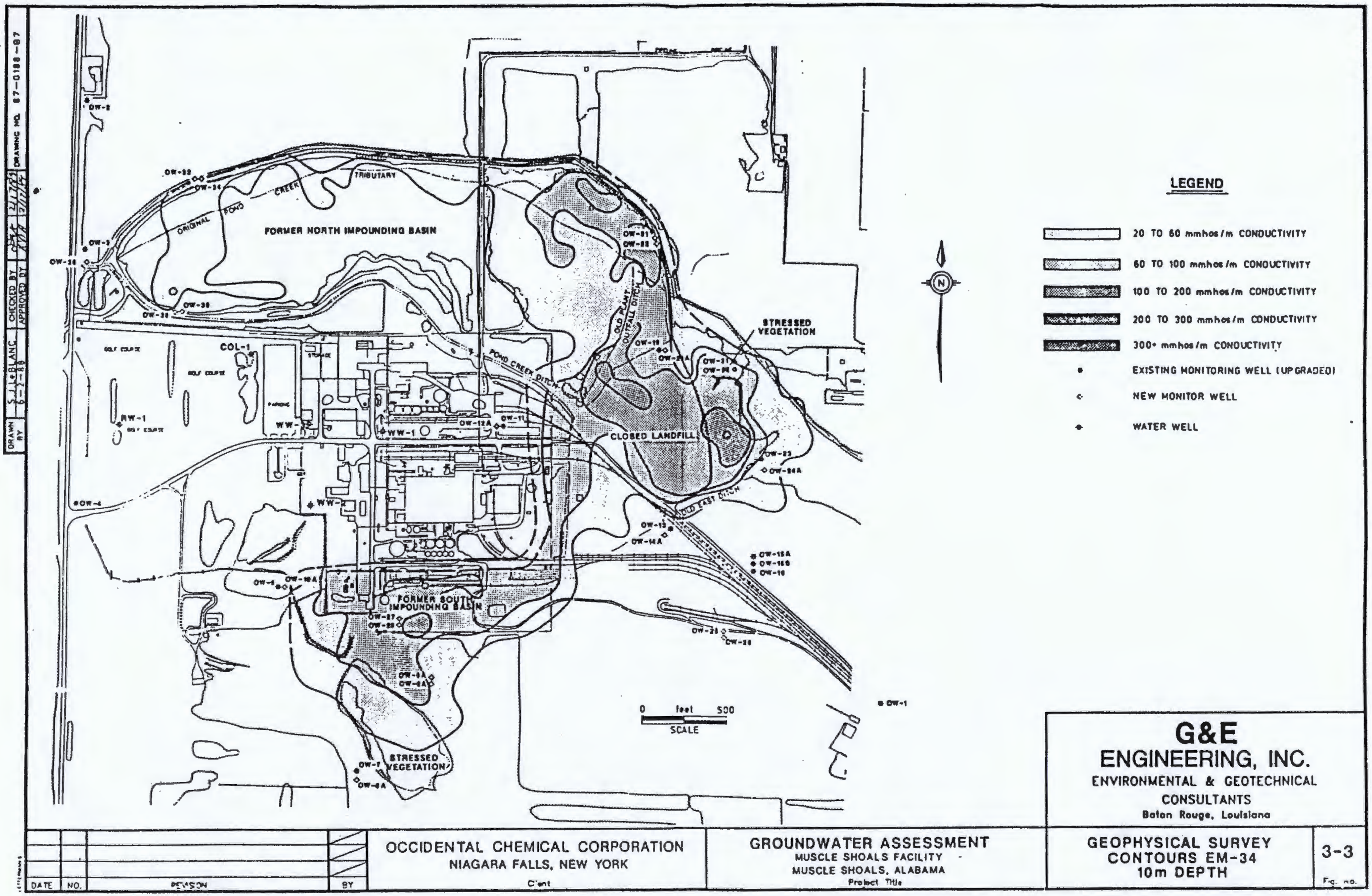


Figure III–3
Geophysical Survey 10m Depth

(Source: Reference 10)

Figure III-4

Geophysical Survey 20 Meter Depth

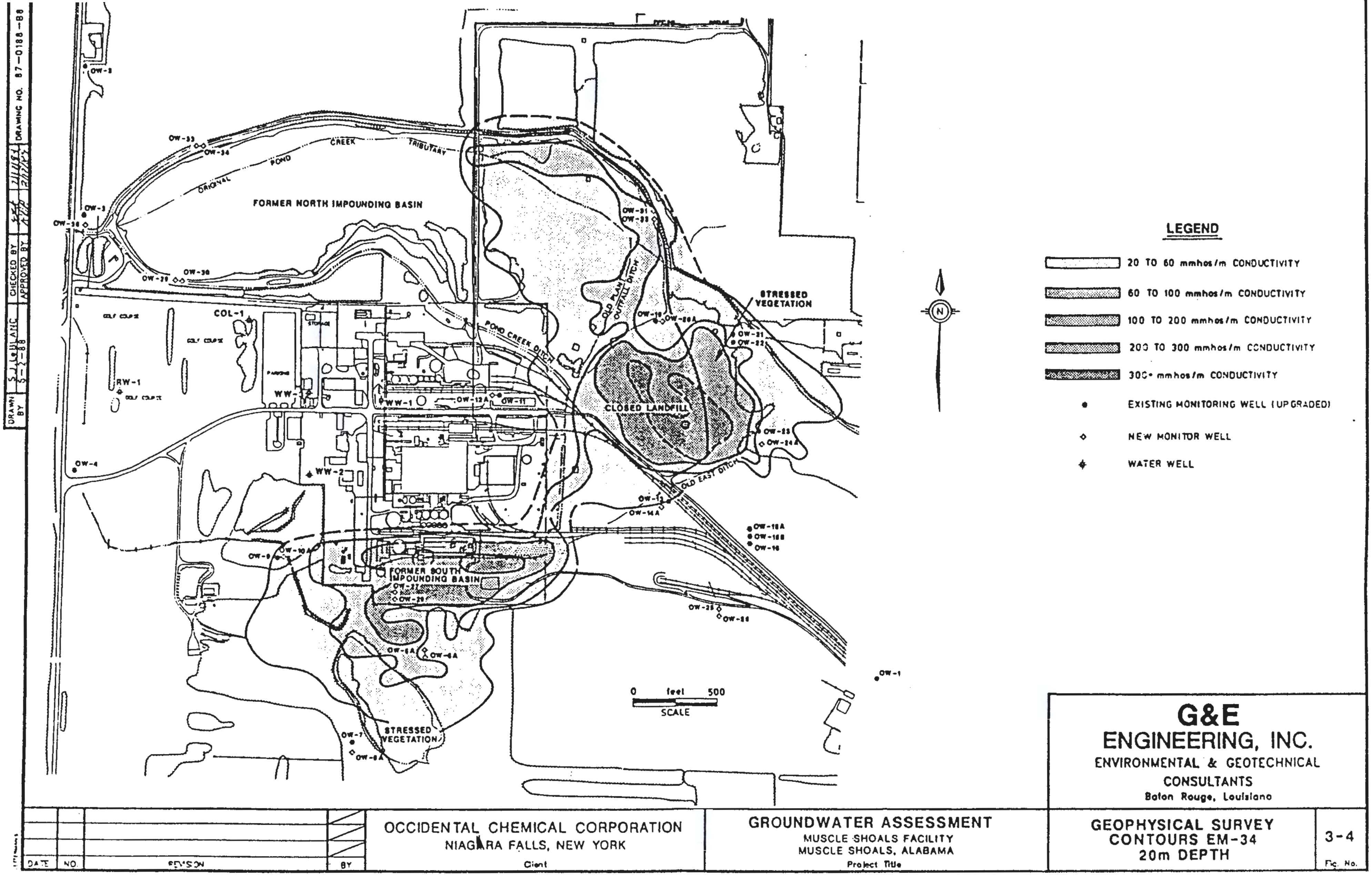


Figure III–4
Geophysical Survey 20m Depth

(Source: Reference 10)

Figure III-5

Geophysical Survey 40 Meter Depth

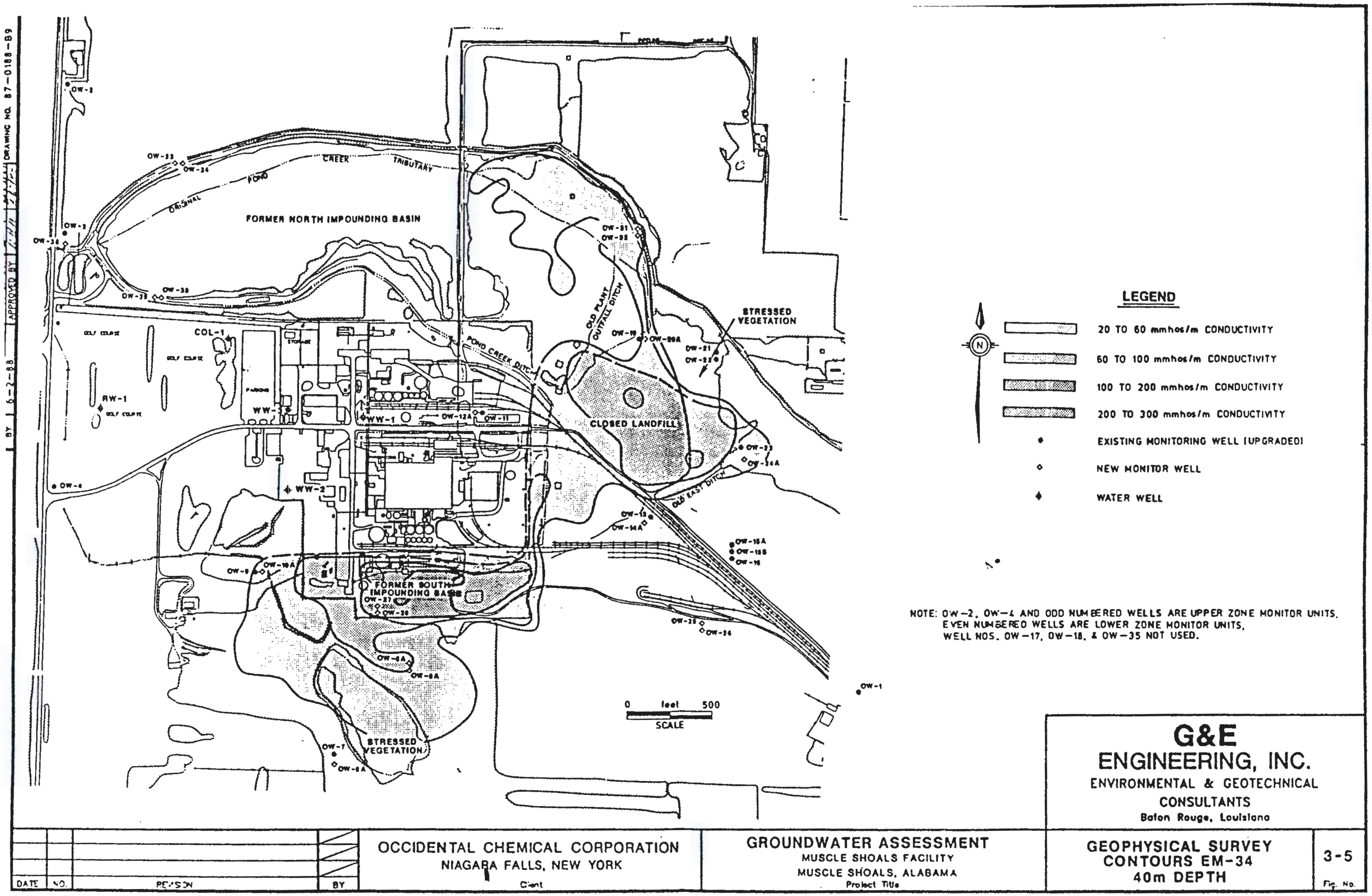


Figure III–5
Geophysical Survey 40m Depth

(Source: Reference 10)

29 and 30). The sediments and soils in the former impoundment were sampled on two locations in 1981 and all metals were below 10% of the Alabama Department of Public Health Toxicant Extractant Procedure (TEP) hazardous waste limits. Three of 107 sediment samples tested for mercury exceeded the primary Drinking Water standard of 2 $\mu g/l$ (these samples contained 5.7 $\mu g/l$, 3.8 $\mu g/l$, and 2.3 $\mu g/l$ mercury). After review of the data, the Department of Public Health sent a letter to Diamond Shamrock Corporation indicating that it was their opinion that the hazardous constituents in the impoundment "are in such small quantities that they pose no harm to the environment".**

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 10, 18, 21, 22, 23

COMMENTS: **It should be noted that the indication by the Department of Health that the basin did not pose a threat to the environment predates the geophysical study that gave strong indications of contaminants in the soils beneath the impoundment. The sampling locations used to evaluate the basin (Reference 22) do not appear to have adequately characterized the subsoils in areas where high readings were obtained in the geophysical survey. A thorough evaluation should be made of the subsoils and sediments in the basin, especially in the area associated with the former path of the old plant outfall ditch.

Also note that concentrations of mercury in soil samples previously collected from this unit (Reference 22) were evaluated on the basis of the Alabama Department of Public Health TEP procedure. Thus, total mercury concentrations of soils located in this unit have yet to be fully evaluated.

A detailed evaluation should be conducted of the soils and construction debris placed in the southwest corner of this unit. An effort should be made to determine the origin of the soils and debris, as well as the likelihood of these materials being contaminated. Procedures should be implemented to ensure that contaminated materials are not relocated within the facility in such a way as to spread contamination.

SWMU NUMBER: 4 **PHOTOGRAPH NOS:** 4.1-4.2

NAME: Salt Storage Piles

TYPE OF UNIT: Abovegrade Storage Pads

PERIOD OF OPERATION: 1953-1991 (NaCl Storage) and 1976-1991 (KCl storage)

PHYSICAL DESCRIPTION AND CONDITION: The pads are located approximately 200 feet southeast of the Mercury Cell Building. The KCl pad (see Photograph 4.1, Appendix B) has an asphalt base with a curb. The salt was reportedly covered with a tarp during the period in which the pad was in service. One NaCl pad had a concrete base with a curb and another had an asphalt base with a curb (see Photograph 4.2, Appendix B). None of the three pads were being used to store salt during the VSI; steel hoppers located next to the railroad tracks are now used to receive and store salt.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: No wastes were ever managed at these units; however, the units have been identified as SWMUs based on the documented evidence of routine, systematic release. The KCl pad stored approximately 1,500 tons at a time (a total of up to 110,000 tons per year). There were two locations for NaCl surface storage; these pads handled 8,000 to 12,000 tons at a time (up to 150,000 tons per year). Both the salts have impurities (such as cadmium) in addition to the primary constituents sodium, potassium and chloride.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (H) Groundwater (H) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): Geophysical studies have detected the presence of "ionic mobility constituents" in the soil and groundwater adjacent to and under the former Salt Storage Piles, SWMU 4, (see Figures III-1 through III-5, beginning on page III-11). While the mercury, cadmium and chloride plumes do extend beneath these areas (see Figures II-14 through II-18, beginning on page II-31), the area immediately under and adjacent to the pads have not been thoroughly characterized.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 10, 18

COMMENTS: The extent of contamination under and adjacent to the former Salt Storage Piles (SWMU 4) should be characterized as part of the RFI.

SWMU NUMBER: 5 **PHOTOGRAPH NO.:** 5.1

NAME: Brine Filter Backwash Collection Tank

TYPE OF UNIT: Abovegrade tank

PERIOD OF OPERATION: 1990-Present

PHYSICAL DESCRIPTION AND CONDITION: This unit is one of the 105,000-gallon open-top steel tanks formerly used as brine saturation tanks. It is located approximately 200 feet south of the mercury cell room building. Backwash water from the brine filters is sent to this unit prior to being sent to the Wastewater Treatment Frame Filter Presses (SWMU 17).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The only waste managed by the unit is the backwash from the brine filters.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): None

RECOMMENDATIONS: No Further Action (*)
Confirmatory Sampling ( )
RFI Necessary ( )

REFERENCE(S): None

COMMENTS: None

SWMU NUMBER: 6 **PHOTOGRAPH NO.:** 6.1-6.2

NAME: Sludge Pads

TYPE OF UNIT: Sludge Storage Areas

PERIOD OF OPERATION: 1953 to Present (NaCl Sludge Pad) and 1976 to October 1991 (KCl Sludge Pad)

PHYSICAL DESCRIPTION AND CONDITION: All of these units were concrete lined (see Photograph 6.2, Appendix B) and were used for the abovegrade storage of waste. Dimensions of the pads are shown on the SWMU location map in Appendix C. While the NaCl sludge pad was still in operation at the time of the VSI, the KCl sludge pad (see Photograph 6.1, Appendix B) had recently been taken out of service and covered with an additional layer of asphalt. The pads are located southwest (KCL sludge pad) and southeast (NaCl sludge pad) of the Mercury Cell Building. The function of the pads was to separate precipitates from the process brine. Unit throughput was 1,500 tons per year for the KCl pad and 2,500 tons per year for the NaCl pad.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Wastes managed by the units were carbonate and hydroxide precipitates with residual salts (30 $\mu g/g$ of either NaCl or KCl) and mercury.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (U)* Groundwater (U)* Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): Geophysical studies in the area surrounding these pads (see Figures III-1 through III-5, beginning on page III-11) have indicated the presence of "ionic mobility constituents". In addition, previous groundwater samples have identified mercury and chloride contamination (Figures II-14 through II-18, beginning on page II-31).

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 18

COMMENTS:

The RFI process should determine the extent of contamination under and immediately adjacent to the pads to assess the contribution of these units to the contamination underlying the site.

*The release potentials for the air and subsurface gas pathways were listed as unknown because there was no information available on the potential for mercury vapors to migrate from the unit.

SWMU NUMBER: 7 **PHOTOGRAPH NO.:** 7.1

NAME: Mercury Cell Room Trench System

TYPE OF UNIT: Trench/Sump

PERIOD OF OPERATION: 1953-Present

PHYSICAL DESCRIPTION AND CONDITION: The cell room trench system is constructed belowgrade in the floor of the Mercury Cell Building. The unit consists of approximately 10 lateral trenches connected to a primary trench which drains to a sump. The trenches are approximately 8 to 12 inches deep and 18 inches wide. The original material of construction for this unit could not be identified, but the trench system was at least partially renovated several decades ago (in 1961 or shortly thereafter). The renovated trenches were constructed from 8-inch thick Gunite underlain by 12-mil polyethylene and slag fill. The Gunite surface was finished with a 1/16-inch coating of carboline epoxy. The unit drains the floor underlying the process mercury cells (located overhead). Build-up of contaminants on the surface of electrolytic cells are routinely washed down by hose and the mercury-bearing washdown waters are received by the underlying trench system and accumulated at the cell room sump (see Photograph 7.1, Appendix B). Wastewaters are piped from the sump to the facility wastewater treatment plant, and sludge is manually removed from the sump on a periodic basis and sent to the Mercury Retort Tanks (SWMU 9).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The unit manages mercury contaminated washdown waters and sludges generated from process electrolytic cells.

RELEASE PATHWAYS: Air (U)* Surface Water (L) Soil (M-H) Groundwater (M-H) Subsurface Gas (U)*

HISTORY AND/OR EVIDENCE OF RELEASES(S): Trench plan reference drawings indicate that the trench system was rebuilt sometime during or after 1961 (Reference 33). Plans for the installation of the new trench system indicate that the former trench system was excavated to a depth of two feet and that the excavated materials were sufficiently contaminated to justify processing for mercury reclamation.

RECOMMENDATIONS: No Further Action ( )
Confirmation Sampling ( )
RFI Necessary (*)

REFERENCE: 28, 33, 36

COMMENTS: Considering 1) the concentrated nature of the wastewaters which have been routed through the trench system; 2) the indication that soil under the trench was sufficiently contaminated to warrant its processing to recover mercury; and 3) the fact that this unit has been in service for nearly four decades, an investigation of the soils beneath this system is warranted to determine if this area is a significant source for the continuing release of mercury to groundwater below the mercury cell room building.

*The release potentials for the air and subsurface gas pathways were listed as unknown because there was no information available on the potential for mercury vapors to migrate from the unit.

SWMU NUMBER: 8 **PHOTOGRAPH NO.:** 8.1

NAME: Former Hypalon-Lined Storage Tank Location

TYPE OF UNIT: Former Abovegrade Steel Tank

PERIOD OF OPERATION: 1976-1981

PHYSICAL DESCRIPTION AND CONDITION: According to facility personnel, the unit was an abovegrade steel tank which temporarily stored process wastewaters. No information regarding the tanks dimensions, capacity or any associated release controls have been identified. When the unit was disassembled in 1983, no closure plan was written and no data on underlying soils was collected. The unit was located immediately west of the Former South Impounding Basin (SWMU 2).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: An unspecified quantity of wastewater from the Mercury Cell Room Trench System (SWMU 7) was managed at the unit. Primary constituents managed at the unit included mercury and chlorides. Although the concentration of mercury present in this wastewater was not recorded, historical information would suggest mercury concentrations in wastewaters managed at the unit were likely to have been in the parts per million range.

RELEASE PATHWAYS: Air (L) Surface Water (U)* Soil (U)*
Groundwater (U)* Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): None

RECOMMENDATIONS: No Further Action ( )
Confirmation Sampling ( )
RFI Necessary (*)

REFERENCE: 28

COMMENTS:

*This unit is located immediately north of the Stressed Vegetation Area (AOC D). As a result of the lack of soil analytical data for this area, the potential for releases to soil, surface waters and groundwater remains unknown. However, the location of the unit suggests the possibility of releases from this unit to the adjacent AOC D, either by subsurface seepage or deliberate overland discharges from the unit. As part of the RFI, a detailed assessment of soils in the vicinity of the former unit is suggested to determine whether soils at this location are a continuing source for the release of hazardous constituents to the environment.

SWMU NUMBER: 9 **PHOTOGRAPH NO.:** 9.1

NAME: Mercury Retort Tanks (2)

TYPE OF UNIT: Tanks

PERIOD OF OPERATION: 1988-Present

PHYSICAL DESCRIPTION AND CONDITION: The abovegrade steel tanks have an apparent capacity of greater than 100 gallons and are high temperature retort furnaces used for the recovery of mercury from the various waste streams listed below. The recovered mercury and some mercury contaminated wastewater are discharged directly to the Mercury Collection Vessel (SWMU 10). The units, which are situated on a concrete pad, are located approximately 100 feet west of the mercury cell room building, approximately 70 feet south of the northwest corner of the building.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The following waste materials are treated at the unit:

Funda and Adams filter cake
H_2 Adsorber carbon
Decomposer graphite
Waste water treatment filter cake
Waste water treatment carbon tower material
Mercury cell room trench sludges
Contaminated soils

An approximate volume of 200 tons per year of retorted carbon materials (K106) are generated at the unit. The primary emissions of the unit are combustion by-products (noncontact) and water vapor (Reference 35).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28, 35, 36, 37, 38, 43

COMMENTS: None

SWMU NUMBER: 10 **PHOTOGRAPH NO.:** 10.1-10.2

NAME: Mercury Collection Vessel

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1988-Present

PHYSICAL DESCRIPTION AND CONDITION: This abovegrade steel tank is located in an outdoors area adjacent to the Mercury Retort Tanks (SWMU 9), approximately 70 feet west of the mercury cell room building and approximately 70 feet south of the northwest corner of the building. The tank accumulates mercury recovered from waste materials subjected to retort in the Mercury Retort Tanks (SWMU 9).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Visual observations made at the time of the VSI suggested that there is routine release of mercury or mercury-contaminated wastewaters to the surrounding concrete and to the adjacent inlet to the Industrial Sewer System, SWMU 14 (see Photographs 10.1 and 10.2, Appendix B).

RELEASE PATHWAYS: Air (U)* Surface Water (U)* Soil (U) Groundwater (U)* Subsurface Gas (U)*

HISTORY AND/OR EVIDENCE OF RELEASES(S): Visual observations made at the time of the VSI indicated that this tank may periodically release mercury or mercury-contaminated wastewaters to the Industrial Sewer System (SWMU 14) which in turn discharges to the NPDES Outfall Ditch (SWMU 16). Stained concrete was observed adjacent to the unit from the point at which a water purge line emptied from the tank (see Photograph 10.2, Appendix B). The stained surface extended for several feet to a sewer drain. A second area of stained concrete was observed nearby, apparently as the result of spillage or overflow during transfer of mercury from the collection vessel to an adjacent transfer container box (see right foreground of Photograph 10.1, Appendix B). The drainage pathway of this second release source, as revealed by concrete staining, followed the general slope of the concrete surface and was observed to gradually diffuse until no longer visible. It is likely that hazardous constituents potentially released at the transfer box would also be likely to drain into the Industrial Sewer System (SWMU 14) at other inlet points.

RECOMMENDATIONS: No Further Action ( )
Confirmation Sampling ( )
RFI Necessary (*)

REFERENCE: None

COMMENTS: As part of the RFI, it is suggested that the facility analyze the water contained in these vessels as an indication of the quantity of mercury that has been released by the unit. Furthermore, as an interim measure, the practice of uncontrolled release of mercury wastewaters to the surrounding area and the Industrial Sewer System (SWMU 14) should be stopped immediately and the area should be decontaminated.

*The release potentials for the air, surface water, soil, groundwater and subsurface gas pathways were listed as unknown because it was either not possible to quantify the probable releases or there was no information available on the potential for mercury vapors to migrate through soil in the vapor phase.

SWMU NUMBER: 11 **PHOTOGRAPH NO.:** 11.1

NAME: Hazardous Waste Roll-Off Pad

TYPE OF UNIT: Storage Pad

PERIOD OF OPERATION: 1985-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit, which measures 14 feet by 80 feet, consists of an 8-inch concrete slab overlain by 4 to 6 inches of asphalt. The pad is curbed to prevent run-on and runoff. In the past this unit also stored bulk uncontainerized waste (SWMU 23).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The following wastes are managed at the unit:

Waste	Annual Volume
Wastewater sludge (K106)	50-100 tons
Mercury-contaminated carbon (D009)	50-150 tons
KCl saturator sludge (K071)	1-5 tons
KCl clarifier sludge (K071)	300-600 tons
Mercury-contaminated debris (D009)	50-200 tons

Wastes stored at the unit are currently contained in drums or covered rolloff containers. According to facility representatives, wastes are not stored in this unit in excess of the 90-day storage limitations mandated under RCRA regulations. Wastes are shipped offsite to a RCRA-permitted hazardous waste landfill at Emelle, Alabama.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28, 34, 37, 40

COMMENTS: The ditch sediments and soils underlying the ditch should be sampled and analyzed as part of the RFI.

SWMU NUMBER: 12 **PHOTOGRAPH NO.:** 12.1-12.2

NAME: Emergency Chlorine Scrubber Tanks (2)

TYPE OF UNIT: Tanks

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: The two 55,000-gallon steel tanks receive discarded chlorine product directed to the unit as needed on an emergency basis. The units are situated on an abovegrade concrete structure that is partially surrounded by approximately 6-inch high concrete curbing. The tanks are located approximately 450 feet east and 450 feet south of the southeast corner of the mercury cell room building.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Waste chlorine piped to the unit is mixed with 20% sodium hydroxide (NaOH) in the scrubber tanks to produce sodium hypochlorite (NaOCl, i.e., bleach). Upon depletion of the NaOH, the scrubber solution is piped to the adjacent Scrubber Solution Treatment Tank (SWMU 13). The unit generates approximately 15 tons of waste per year. This waste is suspected to be hazardous, based on the characteristic of corrosivity (D003).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28

COMMENTS: The facility should determine if this waste is correctly classified as corrosive hazardous waste (D003).

SWMU NUMBER: 13 **PHOTOGRAPH NO.:** 13.1-13.2

NAME: Scrubber Solution Treatment Tank

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit is a 55,000-gallon open-top tank located adjacent to the Emergency Chlorine Scrubber Tanks (SWMU 12). The tank is underlain by a concrete pad and is located adjacent to SWMU 12, approximately 450 feet east and 250 feet south of the southeast corner of the mercury cell room building.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Waste materials managed at this unit consist of scrubber solution (sodium hypochlorite) piped from the adjacent Emergency Chlorine Scrubber Tanks (SWMU 12). The waste solution is treated with sodium sulfite to produce nonhazardous NaCl and sodium sulfate constituents prior to its release to the Industrial Sewer System (SWMU 14) immediately upgradient of the facility NPDES Outfall Ditch (SWMU 16). Although the precise quantity of wastes managed at the unit could not be provided by facility representatives, based on inputs from the Emergency Chlorine Scrubber Tanks (SWMU 12), an approximate volume of at least 15 tons per year of treated wastewater materials are managed at this unit.

RELEASE PATHWAYS: Air (L) Surface Water (U)* Soil (U)*
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action ( )
Confirmation Sampling ( )
RFI Necessary (*)

REFERENCE: 28

COMMENTS:

During the VSI, a strong bleach odor was emanating from the Industrial Sewer System (SWMU 14) immediately downgradient of the point where the treated scrubber solution is released. It is suggested that as part of the RFI, the facility evaluate the treated scrubber solution released to the Industrial Sewer System for hazardous constituents and hazardous characteristics.

*The release potentials for the surface water and soil pathways from this unit are unknown because the constituents in the wastewaters released to the Industrial Sewer System (SWMU 14) have not been quantified.

SWMU NUMBER: 14 **PHOTOGRAPH NO.:** 14.1-14.6

NAME: Industrial Sewer System

PERIOD OF OPERATION: 1951-Present

PHYSICAL DESCRIPTION AND CONDITION: The Oxychem facility was built during 1952 to 1953, and most of the sewer lines (constructed of reinforced concrete) were installed during construction of the plant (Figure III-6) and are still in use. Various new lines constructed of vitrified clay have been added to the system over time and a length of sewer pipe southwest of the Mercury Cell Building and running due east was removed from service in 1976 (see Figure II-2, page II-8). A study of the system conducted in 1989 showed the build-up of insoluble salts in the older sections and some of the newer sections of pipe (Reference 24). No special sealing material was used at the joints of the pipe and therefore seepage occurs at all of these junctions.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Wastewaters received by the sewer system (see Photographs 14.1-14.6, Appendix B) have contained high concentrations of mercury and all other contaminants in the liquids that either entered the Mercury Cell Room Trench System (SWMU 7), other drains to the Industrial Sewer System, or stormwater runoff from the plant. Prior to 1980, unknown quantities of F001 wastes (spent carbon tetrachloride solvents and still bottoms) generated at the Carbon Tetrachloride Stripper (SWMU 22) were also discharged to this unit.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (H) Groundwater (H) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): While the sewers have not been specifically linked to the general contamination of soil and groundwater adjacent to the sewers, they have conveyed contaminated water through unsealed pipes and have contributed to the contamination beyond the points at which the sewers discharge to area drainage ditches (see Photographs 14.3 and 14.6, Appendix B).

Figure III-6

Industrial Sewer Route

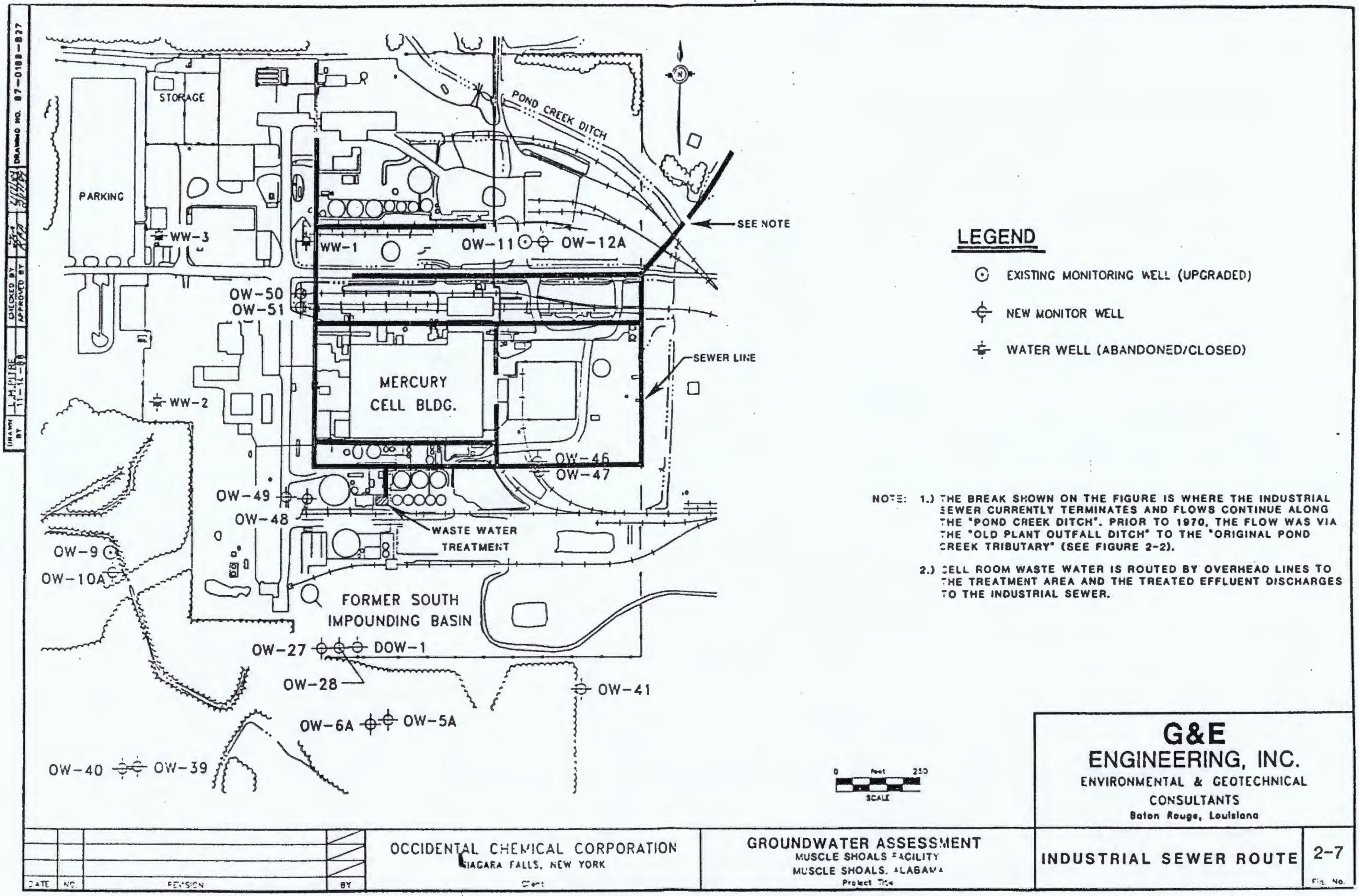


Figure III–6
Industrial Sewer Route

(Source: Reference 10)

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 10, 18, 24

COMMENTS: There should be an assessment of past and present wastes disposed in the sewers. As an interim measure, the discharge from the Mercury Collection Vessel (SWMU 10) is an example of a continuing release of mercury contaminated waters entering the sewer system which should cease immediately. The RFI should define the extent of contamination under and immediately adjacent to the sewers to determine to what degree they have contributed to and continue to contribute to the contamination underlying the area.

SWMU NUMBER: 15 **PHOTOGRAPH NO.:** 15.1-15.4

NAME: Old East Outfall Ditch

TYPE OF UNIT: Earthen Ditch

PERIOD OF OPERATION: 1953-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit is an earthen ditch approximately 600 feet long, that is located approximately 300 feet east of the electricity substation and runs from south to north (see Photograph 15.1-15.3, Appendix B). It enters the NPDES Outfall Ditch (SWMU 16) at the southern most end of the Former North Impounding Basin (SWMU 3).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: This unit received all wastewaters and runoff that exited the sewer outfalls along the eastern side of the facility. Waste constituents managed at this unit include mercury and chloride.

RELEASE PATHWAYS: Air (L) Surface Water (H) Soil (H)
Groundwater (H) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): The extent of contaminant migration associated with this ditch was not provided in the available file material.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 1, 10, 18, 24

COMMENTS: The RFI for this unit should assess the sediments and subsoils underlying this ditch to determine the extent of contamination.

SWMU NUMBER: 16 **PHOTOGRAPH NO.:** 16.1-16.2

NAME: NPDES Outfall Ditch

TYPE OF UNIT: Earthen Ditch

PERIOD OF OPERATION: 1971-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit is an earthen ditch that extends from the southern most end of the Former North Impounding Basin (SWMU 3) to the NPDES outfall located near the western end of the basin, just East of Wilson Dam Road (see Photographs 16.1 and 16.2, Appendix B). The ditch receives 8,000 to 12,000 gpm of flow.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: This unit receives a mixture of treated wastewaters; stormwater runoff; washings from tank cars, barge tanks and chlorine storage tanks; noncontact process water and certain other untreated contact wastewater (such as that pictured in Photograph 10.2, Appendix B). The flow enters the ditch at various points beginning at the point of discharge of the Old East Outfall Ditch (SWMU 15).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (M)
Groundwater (M) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): The extent of contaminant migration associated with this ditch was not provided in the available file material.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 1, 10, 18, 24

COMMENTS: The RFI for this unit should assess the sediments and subsoils underlying this ditch to determine the extent of contamination.

SWMU NUMBER: 17 **PHOTOGRAPH NO.:** 17.1-17.2

NAME: Wastewater Treatment Frame Filter Presses

TYPE OF UNIT: Plate and frame filters

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit consists of three plate and frame filter systems. Two of the units operate in parallel while the third unit is idle or under repair. These presses, which filter K071 brine sludges piped from the Brine Clarifier Tanks (SWMU 5), are located in the vicinity of the wastewater treatment facility. Filtrate brine liquids passing through the filter units are returned to the electrolytic process.

These in-line filter units are part of the wastewater treatment system and are located outdoors approximately 50 feet from the remaining wastewater treatment units. KCl sludge materials generated at the unit are accumulated in subtending hoppers prior to transfer to the Mercury Retort Tanks (SWMU 9).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The frame and filter presses manage approximately 150 tons per year of wastewater treatment sludges (K106) and 600 tons per year of brine sludge (K071).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28, 36, 38, 39

COMMENTS: None

SWMU 18

SWMU NUMBER: 18 **PHOTOGRAPH NO.:** 18.1

NAME: Former PCB Storage Area

TYPE OF UNIT: Storage Building

PERIOD OF OPERATION: 1980-July 1987

PHYSICAL DESCRIPTION AND CONDITION: The unit is a storage building with a concrete floor that has been converted into dry goods and tool storage (see Photograph 18.1, Appendix B). The building is located in the maintenance shop area west of the Mercury Cell Building. Wastes managed at the unit were shipped offsite to a RCRA permitted disposal facility.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: During its use for storage of PCBs, approximately 200 drums per year moved through this unit. The drums held PCB containing oils and debris from PCB spills.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmatory Sampling ( )
RFI Necessary ( )

REFERENCE(S): 18

COMMENTS: None

SWMU NUMBER: 19 **PHOTOGRAPH NO.:** 19.1

NAME: 500,000-Gallon Wastewater Storage Tank

TYPE OF UNIT: Abovegrade Tank

PERIOD OF OPERATION: 1981-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit is a painted 500,000-gallon steel tank (see Photograph 19.1, Appendix B) that stores Mercury Cell Building trench water and stormwater surge which exceeds the capacity of the wastewater treatment plant. It is located southwest of the Mercury Cell Building. Mercury cell room wastewaters and initial stormwater surge are piped to the unit for storage until there is available capacity in the wastewater treatment plant.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The unit stores stormwater surge and mercury-containing wastewaters collected in the Mercury Cell Room Trench System (SWMU 7). Approximately 50 tons per year of waste sludges (D009) are generated in the tank.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmatory Sampling ( )
RFI Necessary ( )

REFERENCE(S): 18

COMMENTS: None

SWMU NUMBER: 20 **PHOTOGRAPH NO.:** Unit not Located

NAME: Wastewater Treatment Hydrazine Reaction Tank

TYPE OF UNIT: Abovegrade Tank

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: This 3,400-gallon capacity abovegrade steel tank, positioned on a concrete containment pad, is located in the wastewater treatment area of the facility. No additional information was identified on the physical description of this unit.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Mercury-bearing wastewaters are treated with hydrazine to form a precipitant. Wastewaters and precipitated solids are subsequently pumped from the tank for further treatment in the Wastewater Treatment Frame Filter Presses (SWMU 17). Filtered wastewaters exiting the presses are then transferred to the Carbon Polishing Towers (SWMU 21) for final polishing prior to release to the NPDES Outfall Ditch (SWMU 16).

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 28

COMMENTS: None

SWMU NUMBER: 21 **PHOTOGRAPH NO.:** Unit Not Located

NAME: Wastewater Treatment Carbon Polishing Towers (3)

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1974-Present

PHYSICAL DESCRIPTION AND CONDITION: These three abovegrade steel tanks (one 14 feet by 42 inches and two 15 feet by 42 inches) are located in an enclosed area in the wastewater treatment area of the facility. The units provide a final carbon-filtration polishing to treated wastewaters prior to release to the facility Industrial Sewer System (SWMU 14) and subsequently to the NPDES Outfall Ditch (SWMU 16).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The units manage a combined annual volume of approximately 100 tons per year of mercury-contaminated carbon filter material (K106 waste) which are transferred to the Mercury Retort Unit (SWMU 9) for treatment.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 38, 39

COMMENTS: None

SWMU 22

SWMU NUMBER: 22 **PHOTOGRAPH NO.:** Unit Not Located

NAME: Carbon Tetrachloride Stripper

TYPE OF UNIT: Tank

PERIOD OF OPERATION: 1956-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit consists of a tank measuring 3 feet in diameter by 56 feet high. The unit was not viewed at the time of the VSI. The tank is located in the northeast corner of the mercury cell room building. The unit is situated on a concrete pad with a surrounding trench and sump collection system. It recovers chlorine collected from various process sources.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The unit manages approximately 5 tons per year of F001 waste (spent solvents and/or solvent bottoms). According to facility personnel, accumulated wastes are removed from the unit during routine maintenance operations and ultimately disposed of at the hazardous waste landfill in Emelle, Alabama.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASES(S): No evidence of release was identified in the available file material or during the VSI.

RECOMMENDATIONS: No Further Action (*)
Confirmation Sampling ( )
RFI Necessary ( )

REFERENCE: 38, 39, 42

COMMENTS: Prior to 1980, F001 wastes generated at this unit were discharged to the Industrial Sewer System (SWMU 14).

SWMU NUMBER: 23 **PHOTOGRAPH NO.:** 23.1

NAME: Southern Stormwater Discharge Ditch

TYPE OF UNIT: Ditch

PERIOD OF OPERATION: Unknown-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit is an unlined ditch. It runs under the facility fence southwest of the Former South Impounding Basin (SWMU 2) and continues down to the Gravel Areas Adjacent to Electrical Substation (AOC C).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The material discharging to the ditch at the time of the VSI (see Photograph 23.1, Appendix B) appeared to be contaminated stormwater draining from facility production areas to the north. Consequently, the ditch has possibly received wastewaters contaminated with mercury and chlorides and may be a route by which contaminants were transported to AOC C.

RELEASE PATHWAYS: Air (L) Surface Water (H) Soil (H)
Groundwater (L-M) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): There was evidence of a continuing release of apparently contaminated water during the VSI. There has been documented contamination of areas south and downgradient of the ditch.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 1, 10, 18

COMMENTS: The ditch sediments and soils underlying the ditch should be sampled and analyzed as part of the RFI.

SWMU NUMBER: 24 **PHOTOGRAPH NOS: 24.1-24.3**

NAME: Stressed Vegetation Area South of Former South Impounding Basin

TYPE OF UNIT: Former Discharge Area

PERIOD OF OPERATION: Unknown-Present

PHYSICAL DESCRIPTION AND CONDITION: The unit is a geographic low located south of the Southern Stormwater Discharge Ditch (SWMU 23). This area was previously covered in trees at one time (as can be seen in the 1963 aerial photograph). It is now vegetated with aquatic species such as cattails and sedges. An earthwork associated with the construction of a facility golf course may have blocked the natural drainage path for the area. The vegetative cover has died in portions of this unit, and the aerial photographs taken of the area over time indicate that the area of dead vegetation has existed for decades.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: One of the materials discharged to the area was excess brine. No information was located on the volume or frequency of the discharges to the area. The potential exists for the discharge of contaminated stormwater to this area through the southern Stormwater Discharge Ditch (SWMU 23).

RELEASE PATHWAYS: Air (L) Surface Water (H) Soil (H) Groundwater (H) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): Analysis of soil, surface water and nearby groundwater has already documented containment releases to the area (see Figures II-14 through II-18, beginning on page II-31). Photograph 23.1 in Appendix B shows that contaminated stormwater runoff continues to be discharged to the area. Geophysical surveys appeared to indicate that there is a continuous subsurface plume of "ionic mobility constituents" extending from the Former South Impounding Basin (SWMU 2) down through the area of dead and stressed vegetation (see Figures III-1 through III-5, beginning on page III-11).

RECOMMENDATIONS:	No Further Action ( ) Confirmatory Sampling ( ) RFI Necessary (*)
REFERENCE(S):	1, 5, 10, 18
COMMENTS:	The RFI should evaluate the sediments and subsoils in the vicinity of this unit, particularly in areas where the geophysical survey has indicated the likelihood of contamination.

SWMU NUMBER: 25 **PHOTOGRAPH NO.:** 25.1

NAME: Waste Pile Storage Areas

TYPE OF UNIT: Waste Piles

PERIOD OF OPERATION: 1980-1984

PHYSICAL DESCRIPTION AND CONDITION: Storage Area A consists of a 3-inch layer of asphalt on top of a 6-inch layer of lime treated subgrade surrounded by a 6-inch asphalt curb. Surface water was diverted by means of a slope to a sump, which routed the wastewater to the wastewater treatment system.

Storage Area B consists of a 4-inch layer of shotcrete placed over 8 inches of reinforced concrete. The unit has a back wall approximately 6 feet tall to minimize the potential for wind dispersal of waste. The unit is still in service and is further described as the Hazardous Waste Roll-Off Pad (SWMU 11).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Storage Area A stored contaminated equipment and a variety of drummed waste including spent filter cakes, spent carbon, waste solvents, cell butter and used motor oil. Storage Area B stored bulk (uncontainerized) hazardous wastes and drummed waste. F001, K106 (wastewater pit sludge) and K071 (saturator sludge and backwash sludge) were also stored at Storage Area B.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (L) Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): Both storage areas were certified as closed by ADEM, and there were no records of releases prior to that time. Storage Area B is now used for 90-day storage of waste (the Hazardous Waste Roll-Off Pad, SWMU 11).

RECOMMENDATIONS: No Further Action (*)
Confirmatory Sampling ( )
RFI Necessary ( )

REFERENCE(S): 26, 27

COMMENTS: Some of the highest readings obtained in the geophysical surveys were centered on the area near Waste Pile B (see Figures III-1 through III-5, beginning on page III-11). The mercury, cadmium and chloride plumes are also centered on this area. The RFI should assess the extent of the soil contamination adjacent to and underneath this unit. Soils should be analyzed for mercury, cadmium, and chloride.

AOC LETTER: A **PHOTOGRAPH NO.:** A.1-A.3

NAME: Junkyard

TYPE OF UNIT: Abovegrade Storage Area

PERIOD OF OPERATION: Unknown-present

PHYSICAL DESCRIPTION AND CONDITION: This unit, which covers several acres, is located east of the pipeline that crosses the Former North Impounding Basin (SWMU 3) and north of the Pond Creek ditch (see Photograph A.1 to A.2, Appendix B). Runoff from the area exits the western end of the unit (see Photograph A.3, Appendix B).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: The unit currently stores a variety of used equipment and debris that has been deemed valuable or reusable. It is not clear whether material placed in this area was decontaminated prior to storage because there does not appear to be either written storage and/or decontamination guidelines or a tracking system to indicate what is or has been stored here.

RELEASE PATHWAYS: Air (L) Surface Water (U) Soil (U)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): While there is photographic evidence that there is uncontrolled surface runoff from the area, there are no known analyses of this water.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 78

COMMENTS: The RFI should evaluate the area and interview facility personnel to determine past and present operating practices for this unit. If contaminated equipment has been stored here, soil samples should be collected and analyzed for the appropriate contaminants.

AOC LETTER: B **PHOTOGRAPH NO.:** B1

NAME: Old TVA Pipeline Right-of-Way

TYPE OF UNIT: Pipeline Right-of-Way

PERIOD OF OPERATION: Unknown-present

PHYSICAL DESCRIPTION AND CONDITION: The right-of-way is approximately 2,000 feet long and 30 feet wide. It extends due east from near the NPDES Outfall Ditch (SWMU 16). The area has been maintained devoid of vegetation to allow access to the pipeline.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: There is no record of wastes having been applied to the area, but it was clear from the visual inspection that chemicals are applied to the area to control vegetation and have apparently been applied to the unit on a routine basis for decades.

RELEASE PATHWAYS: Air (L) Surface Water (L) Soil (H)
Groundwater (L) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): There have been direct applications of chemicals to the area to eliminate plant growth.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 78

COMMENTS: This unit should be investigated to determine past and present pesticide application practices. While it may be that only nonpersistent herbicides have been applied to the soil without any build-up of toxic residues, it would be prudent as part of the RFI to analyze the soil to verify the absence of toxic residues.

AOC LETTER: C **PHOTOGRAPH NO.:** C1

NAME: Gravel Areas Adjacent to Electrical Substation

TYPE OF UNIT: Surface Spill

PERIOD OF OPERATION: Unknown-Present

PHYSICAL DESCRIPTION AND CONDITION: There are large areas covered with fresh gravel in the area within and surrounding the electrical substation and transformers along the outside of the eastern wall of the Mercury Cell Building. During the VSI, the surficial layer of gravel was removed in several spots to examine the underlying gravel (see Photograph C.1, Appendix B). It appeared in several of these locations that the gravel was stained with an oily material that had a petroleum odor.

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Unidentified spill materials were noted during the VSI, and previous samples of soil collected in unpaved areas around the facility have identified the presence of contaminants (see Figure II-7, page II-22). For example, 33,000 μg/kg of mercury were detected in the surface soil just south of the electric substation (soil boring 19 on Figure II-7, page II-22) and 21,000 μg/kg of mercury were identified in soils northwest of the Mercury Cell Building (soil boring 21 on Figure II-7, page II-22).

RELEASE PATHWAYS: Air (L) Surface Water (U) Soil (U)
Groundwater (U) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): There are no documented releases at this unit, but there have been documented spills of PCBs in other areas of the facility.

RECOMMENDATIONS: No Further Action ( )
Confirmatory Sampling ( )
RFI Necessary (*)

REFERENCE(S): 20

COMMENTS: During the VSI, large gravel covered areas were noted east and south of the Mercury Cell Building. It is likely that some of the existing groundwater contamination resulted from contaminants migrating in surface water from process or waste management units to the gravel covered areas and hence downward to the groundwater. In addition, visual observations made at the time of the VSI indicate that several soil or gravel covered areas at the plant are in fact contaminated and may well be a significant continuing source for contaminant release to the environment. The RFI should evaluate the extent of contamination of surface and subsoils around the facility. At a minimum, soils should be analyzed for mercury, cadmium, chloride, and PCBs.

AOC LETTER: D **PHOTOGRAPH NO.:** 1.9-1.10

NAME: Old East Ditch

TYPE OF UNIT: Earthen Ditch

PERIOD OF OPERATION: Unknown

PHYSICAL DESCRIPTION AND CONDITION: There was very little information available regarding this unit. It is, however, noted on several facility maps and there has been some limited sampling in the area. It is not known what contributed to the flow in this ditch but it appeared to originate on the east side of the plant, curve around the southeast side of the Landfill (SWMU 1) and connect into other surface drainage northeast of the Landfill.

During an April 1989 sampling event, the surface water in the ditch downstream of the plant road was "somewhat cloudy and contained a white sheen on the surface but was clear upstream". Another concern is that the flow from the ditch apparently discharges to an area that has stressed vegetation and dead trees (see Photographs 1.9 and 1.10, Appendix B).

WASTES AND/OR HAZARDOUS CONSTITUENTS MANAGED: Some of the contamination found in the sediments and surface water associated with the ditch appear to have originated from lateral migration through the south face of the Landfill (SWMU 1). Analysis of the sediment and surface water upstream of the landfill, however, indicates that there may be other sources of contamination discharging to the ditch. Laboratory results revealed chloride concentrations ranging from 13,000 mg/l to 42,000 mg/l; mercury concentrations ranging from 1.3 mg/l to 120 mg/l; and cadmium concentrations ranging from <5 μg/l to 70 μg/l (Reference 1).

RELEASE PATHWAYS: Air (L) Surface Water (M) Soil (M) Groundwater (L-M) Subsurface Gas (L)

HISTORY AND/OR EVIDENCE OF RELEASE(S): Analysis of sediment and surface water samples from upstream of the Landfill (SWMU 1) showed some mercury and chloride contamination, but the samples collected from the ditch adjacent to the southeast face of the Landfill showed significant mercury, cadmium and chloride contamination.

RECOMMENDATIONS:	No Further Action ( ) Confirmatory Sampling ( ) RFI Necessary (*)
REFERENCE(S):	1
COMMENTS:	As part of the RFI, the source of discharge to the Old East Ditch should be determined and the reason for the stressed vegetation and dead trees at the units outfall should be identified. Sediments and subsoil should be sampled with depth in the old ditch bed to determine the extent of subsurface contamination. This effort should also analyze sediments and subsoils in the areas of apparent stressed or dead vegetation north and northeast of the Landfill (SWMU 1). These areas should specifically include the forested area and any apparent surface water flow paths in the areas north and northeast of the Landfill.

IV. SUMMARY

A major emphasis in the RFI should be to determine what units are a continuing source of release of hazardous constituents to the environment. Examples of potential sources for significant continuing releases would include but not necessarily be limited to the following:

1. The Mercury Cell Room Trench System (SWMU 7) and underlying soils which for decades has managed mercury contaminated wastewaters. (There have been sufficiently high levels of mercury detected in the wastewater and significant seepage beneath the trench system to allow the processing of two feel of soil from beneath these trenches for mercury recovery).

2. The Industrial Sewer System (SWMU 14) and underlying soils that for years received the concentrated untreated wastewaters from the Mercury Cell Room Trench System (SWMU 7).

3. The unlined Old East Outfall Ditch (SWMU 15) and the old plant outfall ditch (within SWMU 3) and underlying soils that for years received untreated wastewater.

4. The Former South Impounding Basin (SWMU 2) and underlying soils where for years large quantities of mercury-contaminated wastewaters were treated to precipitate mercury as a sludge. The facility was designed to allow the treated wastewater to be discharged to the Industrial Sewer (SWMU 14); however, the high rate at which the unlined basin leaked made discharge to the Sewer rarely necessary. The accumulated mercury-rich sludges were buried in the unit when it was taken out of service by simply bulldozing in the berms. Consequently, the facility is in effect, an unlined hazardous waste landfill capped with soil.

5. The unlined Landfill (SWMU 1) where large quantities of a variety of mercury contaminated wastes and other materials were disposed and capped with a cover system that would not meet EPA guidance for hazardous waste disposal facilities. There is only a partial inventory of the variety and amount of wastes that were disposed in this unit and there is a strong possibility that a significant amount of pre-1980 PCB waste and spill debris was also landfilled here. It is not clear if even a RCRA cover system would be effective at limiting the continuing release of contaminants from this unlined area.

There are several large potential sources of continuing contaminant releases. In addition, the long term use of large uncovered salt piles, sludge pads and waste piles also suggests that the area soil may now be a significant source of continuing release of contaminants. Gravel covered areas would have been especially conducive to allowing contaminants to seep into the soil under and adjacent to past and present plant process and waste management facilities.

It is apparent from the facility wide nature of the contamination, that the entire facility should be included in the RFI. In some cases, past investigations have documented the existence but not the full extent of contamination. It should be a central premise of the RFI that both the horizontal and lateral extent of contamination will be defined. The facility should also remediate the existing contamination and deal effectively with the sources of continuing release(s) to the environment.

Chapter IV consists of three tables listing the Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) identified during the VSI conducted on December 12 and 13, 1991. Table IV-1 is a list of SWMUs and AOCs, Table IV-2 identifies the SWMUs and AOCs that require a RFI, and Table IV-3 lists those units requiring no further action at this time.

Table IV-1
List of SWMUs and AOCs

Landfill (SWMU 1)
Former South Impounding Basin (SWMU 2)
Former North Impounding Basin (SWMU 3)
Salt Storage Piles (SWMU 4)
Brine Filter Backwash Collection Tank (SWMU 5)
Sludge Pads (SWMU 6)
Mercury Cell Room Trench System (SWMU 7)
Former Hypalon-Lined Storage Tank Location (SWMU 8)
Mercury Retort Tanks (SWMU 9)
Mercury Collection Vessel (SWMU 10)
Hazardous Waste Roll-Off Pad (SWMU 11)
Emergency Chlorine Scrubber Tanks (SWMU 12)
Scrubber Solution Treatment Tank (SWMU 13)
Industrial Sewer System (SWMU 14)
Old East Outfall Ditch (SWMU 15)
NPDES Outfall Ditch (SWMU 16)
Wastewater Treatment Frame Filter Presses (SWMU 17)
Former PCB Storage Area (SWMU 18)
500,000-gallon Wastewater Storage Tank (SWMU 19)
Wastewater Treatment Hydrazine Reaction Tank (SWMU 20)
Wastewater Treatment Carbon Polishing Towers (SWMU 21)
Carbon Tetrachloride Stripper (SWMU 22)
Southern Stormwater Discharge Ditch (SWMU 23)
Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
Waste Pile Storage Areas (SWMU 25)
Junkyard (AOC A)
Old TVA Pipeline Right-of-Way (AOC B)
Gravel Areas Adjacent to Electric Substation (AOC C)
Old East Ditch (AOC D)

Table IV-2
List of SWMUs and AOCs that Require a RFI

Landfill (SWMU 1)
Former South Impounding Basin (SWMU 2)
Former North Impounding Basin (SWMU 3)
Salt Storage Piles (SWMU 4)
Sludge Pads (SWMU 6)
Mercury Cell Room Trench System (SWMU 7)
Former Hypalon-Lined Storage Tank Location (SWMU 8)
Mercury Collection Vessel (SWMU 10)
Scrubber Solution Treatment Tank (SWMU 13)
Industrial Sewer System (SWMU 14)
Old East Outfall Ditch (SWMU 15)
Southern Stormwater Discharge Ditch (SWMU 23)
Stressed Vegetation Area South of Former South Impounding Basin (SWMU 24)
Waste Pile Storage Areas (SWMU 25)
Junkyard (AOC A)
Old TVA Pipeline Right-of-Way (AOC B)
Gravel Areas Adjacent to Electric Substation (AOC C)
Old East Ditch (AOC D)

Table IV-3
List of SWMUs and AOCs Requiring No Further Action at This Time

Brine Filter Backwash Collection Tank (SWMU 5)
Mercury Retort Tanks (SWMU 9)
Hazardous Waste Roll-Off Pad (SWMU 11)
Emergency Chlorine Scrubber Tanks (SWMU 12)
NPDES Outfall Ditch (SWMU 16)
Wastewater Treatment Frame Filter Presses (SWMU 17)
Former PCB Storage Area (SWMU 18)
500,000-gallon Wastewater Storage Tank (SWMU 19)
Wastewater Treatment Hydrazine Reaction Tank (SWMU 20)
Wastewater Treatment Carbon Polishing Towers (SWMU 21)
Carbon Tetrachloride Stripper (SWMU 22)

V. SUGGESTED RFI STRATEGY

TABLE V-1

Suggested RFI Strategy

UNIT NO.	UNIT NAME	OPERATIONAL DATES	RFI STRATEGY[1]	EVIDENCE OF RELEASE
1	Landfill	1955-1980	analysis of the waste and subsoil (including Hg,Cd and PCBs)	yes
2	Former South Impounding Basin	1970-1976	analysis of the waste and subsoil (including Hg, Cd)	yes
3	Former North Impounding Basin	1970-1971	analysis of the sediments and subsoil in northeast portion of the old plant outfall ditch (including Hg, Cd)	no
4	Salt Storage Piles	1953-1991	analysis of the adjacent soils and subsoil in addition to the subsoils under the unit for Hg, Cl and Cd	yes
6	Sludge Pads	1953- present	analysis of the adjacent soils and subsoil in addition to the subsoils underneath the unit for Hg, Cl and Cd	no
7	Mercury Cell Room Trench System	1953- present	analysis of the trapped sediments, and subsoil for Hg and Cl	yes
8	Former Hypalon-Lined Storage Tank Tank Location	1976-1981	analysis of the adjacent soils and subsoil in addition to the subsoils under the unit for Hg, Cl and Cd	no
10	Mercury Collection Vessel	1988- present	analysis of the wastewaters and black deposits on concrete next to unit for Hg	yes
14	Industrial Sewer System	1953- present	analysis of the trapped sediments, and subsoil for Hg, Cl and Cd	yes

[1] Hg is Mercury, Cd is Cadmium, Cl is chlorides, and PCBs are polychlorinated biphenyls

TABLE V-1

continued

UNIT NO.	UNIT NAME	OPERATIONAL DATES	RFI STRATEGY[2]	EVIDENCE OF RELEASE
15	Old East Outfall Ditch	1953- present	analysis of the sediments and subsoil for Hg, Cl and Cd	no
23	Southern Stormwater Discharge Ditch	unknown-present	analysis of the sediments and subsoil for Hg, Cl and Cd	yes
24	Stressed Vegetation Area South of Former South Impounding Basin	unknown-present	analysis of the sediments and subsoils for Hg, Cl and Cd	yes
25	Waste Pile Storage Areas	1980-1984	analysis of the adjacent soils and subsoil in addition to the subsoils under the unit for Hg, Cl and Cd	no
A	Junkyard	unknown-present	inspection and evaluation of materials stored as well as possible soil sampling	no
B	Old TVA Pipeline Right-of-Way	unknown-present	analysis of the soils	no
C	Gravel Areas Adjacent to Electrical Substation	unknown-present	analysis of the soils and subsoils for Hg, Cl, Cd, and PCBs	no
D	Old East Ditch	unknown	analysis of the sediments and subsoil for Hg, Cl, Cd and PCBs	yes
Off-Site Area	Pond Creek	1953-Present	analysis of the sediments for Hg, Cl, Cd and PCBs	yes

VI. REFERENCES

Please note that the title of the facility is taken directly from the referenced document. The Occidental Chemical facility is also referred to as Oxy-Chemical, OxyChem, Occidental Chemical Corporation, and Occidental Electrochemicals.

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3. G&E Engineering, Inc., Specifications: Improvements to Landfill Cap and Installation of Geomembrane, Muscle Shoals, Alabama. June, (1990).

4. G&E Engineering, Inc. Plans: Improvements to Landfill Cap and Installation of Geomembrane, Muscle Shoals, Alabama, Five Blueprints. (1989).

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7. Woodward-Clyde Consultants, Landfill Cover Evaluation. (April 23, 1981).

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11. G&E Engineering, Inc., Report of Groundwater Assessment of the Muscle Shoals Facility, Muscle Shoals, Alabama, Volume 2 of 4. May 1989.

12. G&E Engineering, Inc., Report of Groundwater Assessment of the Muscle Shoals Facility, Muscle Shoals, Alabama, Volume 3 of 4, May 1989.

13. Letter to Diamond Shamrock Corporation from Woodward-Clyde Consultants concerning a groundwater study for the north impounding basin and landfill area. September 12, 1980.

14. Letter to Olivia H. Jenkins, General Council to the Alabama Department of Environmental Management, from Dennis L. Hallman, Geologist with the Groundwater Branch of the Alabama Department of Environmental Management concerning an Administrative Order Referral for the Occidental Chemical Corporation. (August 8, 1990).

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16. Letter to Andrew A. Lambert of Occidental Chemical Corporation from Fred Mason of the Water Division of the Alabama Department of Environmental Management concerning the Notice of Violation Requirements. (September 26, 1990).

17. Letter to Bernard Cox of Alabama Department of Environmental Management from Steve Callaway, Geologist with the Alabama Department of Environmental Management concerning Diamond Shamrock Groundwater Compliance Inspection, October 16, 1985.

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19. Letter to Regional Administrator, EPA Region IV from Andrew Lampert concerning the cessation of PCB storage at the OxyChem facility at Muscle Shoals, Alabama. June 2, 1987.

20. Letter to Department of Public Safety, State of Alabama from Buddy Cox, Chief of Hazardous and Industrial Waste Section concerning a PCB spill at the Diamond Shamrock Muscle Shoals facility. November 20, 1981.

21. Letter to David Robertson of the Division of Solid and Hazardous Waste, Alabama Department of Public Health from Mel Skaggs of IC&P Environmental Services, Diamond Shamrock concerning the North Impounding Basin Investigation. April 21, 1981.

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31. Letter to Andy Lampert, Plant Technical Manager, Occidental Chemical Corporation, from James H. Scarbrough, Chief, RCRA and Federal Facilities Branch, USEPA Region IV. May 6, 1991.

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65. Alabama Department of Environmental Management Memorandum from Ashley L. Cross, Technical Services Section, to Fred Mason, Groundwater Section, regarding the RCRA status of the Muscle Shoals Plant. August 25, 1989.

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74. Letter to Sonja Massey, Alabama Department of Environmental Management, from Andre E. Lampert, Plant Technical Superintendent, presenting analytical reports of groundwater evaluation and monitoring at the Muscle Shoals Plant. March 4, 1991.

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76. Letter to Gerry Clarke, Plant Manager, Occidental Chemical Corporation, from John Dickinson, Waste Compliance Section, RCRA and Federal Facilities Branch, USEPA Region IV. September 19, 1990.

77. Authorization to Discharge Under the National Pollutant Discharge Elimination System Permit, issued by Alabama Water Improvement Commission, December 31, 1973.

78. VSI observations and VSI log book for the RCRA Facility Assessment was conducted on December 12 and 13, 1991 for the Occidental Chemical Corporation in Muscle Shoals, Alabama.

APPENDIX A

VSI LOG BOOK

Property of ______________________

____

Address ______________________

____

Telephone ______________________

This Book is manufactured of a High Grade, 50% Rag Paper having a Water Resisting Surface, and is sewed with Nylon Waterproof Thread.

INDEX

Occidental ~~Electrochemical~~ CHEMICAL

RFA

Muscle Shoals Plant

Visual Site Inspection

12/12/91

12/12/91

Occidental ~~Electro~~chemical
Muscle Shoals, Al.

- Start-up meeting
  8:30 a.m.

In attendance:

David Anderson
Brian Sullivan } KWBES
Pat Anderson EPA IV
Dan Adams G&E Engineering
Bob Haygood State Alabama
Dave Davis " "
Gerald Clarke OxyChem
Chris Manley "
Andy Lampert "
Ayman El-Hassani State Alabama

Roll 1 P. 1 BPS

2 Pat Anderson

3 Chris Manley

4 Dan Adams

5 Gerald Clarke

6 Andy Lampert

7 Dave Davis

8 Robert Haygood

9 Ayman El-Hussari

Initial discussions focused on historical waste generation wastes.

Further discussions on maps photos/graphics availability.

Plant topographic map provided from 89 G+E report as exhibit 1.

NaCl feedstock entered by ~~truck~~ barge on River Road to dock area (from 64-90).

54-64 NaCl entered by rail

Point A = initial handling location

Salt piles appear to be present in 59 aerial photo.

Also possibly stockpiled as early as 56 in Dome area

Point B = extended NaCl storage area initiated in 54 to mid 90.

Point C = NaCl storage as of 1980 to 1991

Point D = KCl storage area 1980 to mid 90.

C + ~~B~~ D alternated NaCl + KCl over time.

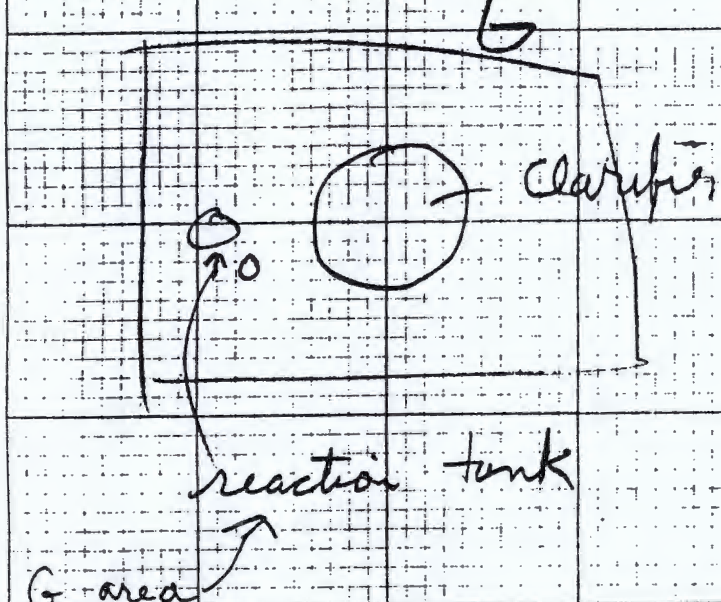
Point E = KCl offloading area

Process flow:

~~Stockpile~~ to brine processing area.

Point F = Resaturator tanks (5)

Brine piped (aboveground) to reaction/clarifier tanks → Point G



Point H = filter unit areas

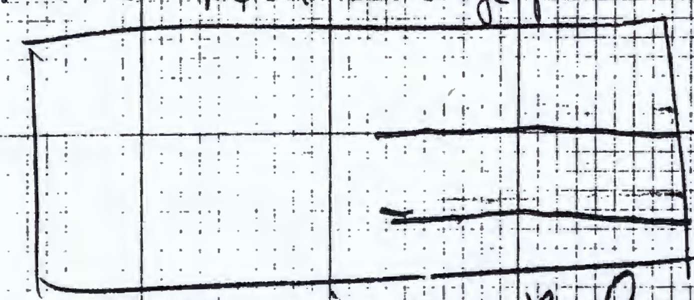
Point I = White muriat potash

WMP treatment area (reaction clarification / filtration)

Point I - mid 70's (76) to 9/91 ~~present~~ - KCl sludge pad

Point G - 54-90 NaCl
90 - present KCl

Point J - ~~Na~~KCl sludge pad



De brining Pads

	KCl sludge	76 to ~~present~~ 9/91
NaCl	"	54 to 90

Point ~~B~~ Mercury cell room

B = concrete
C+D - asphalt
I+J - concrete
plant process - asphalt (w storage tanks, etc set on concrete)

Point K - general ~~w~~ Hg-contaminated sludge/waste pile 1980 →

Historical - Landfill active 54-80 loaded upon best judgement evaluation of sufficient dryness & sent to landfill.

54-80 → 90,000 brine sludge tons to landfill

NaCl feedstock believed to be from Avery Island, La.

KCl feedstock from Canada, various sources (grade, purity were/are variable over time).

J & K are contiguous

Landfill history → (M)

deadline in 11/90 for landfill closure.

Clay cap obtained from borrow area (L).

Woodward-Clyde cap assessment (1st cap)
- permeability
- thickness

2nd cap 9/90
G&E / Delta environmental

First Cap

Dames & Moore report on post-Oxy purchase site assessment?

Landfill wastes
- brine muds
- residual salts
- trace mercury
- saturator bottoms
  Na + Ca SO_3's
  "globurite"
- retorted sludge material
- construction debris

Wastewater historical analysis

from '54-'70 Cell building
~~Trench/process water went~~
from Cell building sump
(middle of south wall) 100 gpm
east out industrial sewer
outfall pipe, gradual merging
w/ other 10,000 gpm wastewater
(including non-contact cooling
water) continued east
approx ~500' E/100' S where
pipe joined w/ N-running
ditch (point of mergence w/

8000 gpm non-contact
cooling H_2O.

Ditch connected to old plant
outfall ditch, through
N-impoundment basin area
to original Pond Creek
tributary, continuing across
Wilson Dam Rd. to Pond
Creek.

'70 → 74 Transitional
period resulting from 69
federal regs.

70-71 Pond Creek diverted
N of N impoundment basin
& old pond creek tributary
metered out near Wilson Dam
road to avoid discharge
exceedances to Pond Creek.

71-74 S. impoundment basin, new outfall ditch constructed

No engineering specs were done on S imp. basin.

Released from basin on metered basis* - pumped to same outfall system as pre-71.

* basin [ ] factored w/ dilution factor of other facility waters to meet acceptable discharge criteria

routed to Q (sump)

150' W of SE corner of cell building

Then east to N-S ditch, crosses tracks & enters Pond Creek ditch (sometimes referred to as Plant Outfall Ditch).

N = cell Building

O = " " Sump

P = S. impoundment basin

Runs south ~~to~~ of N. impoundment berm to outfall across Wilson Dam Rd. to Pond Creek.

Point R

Point S → Pond Creek ditch (plant outfall ditch)

T → old Pond Creek tributary

U → diverted tributary

1974 → & WWTP (wastewater trt plt)
74-76 S. impoundment used
for excess
Hypalon tank used in 76 → 81
to replace S. impoundment
basin. → Point W.
S. impoundment basin closed
in 80, berms pushed in.
no closure evaluation
'74 → reaction tank in
WWTP precipitate Hg
81 - present
.5·10⁶ gallon waste water
storage tank, includes
processwater & initial
S.W. runoff
→ Point V.

80 - present - hay wastes
go to Chemwaste - Emmelle

Wastewater filter cake from
hydrazine/Hg precipitate.

Carbon towers used for
final wastewater polishing

Carbon also sent to Emmelle

Production

Cl^- vacuum extracted
from cells & piped to
liquifaction processing
area - Point X - also Cl^- storage

Liquifaction process
Cl^- cooling steps
H_2SO_4 treatment through Tower
to dewater

H_2SO_4 recycled & sold as dilute product.

Point Y - Caustic filtration

KOH - carbon filtered to remove Hg

carbon retorted to recover Hg.

Point Z - ~~carbon~~ retort ~~tanks~~

(Carbon to ~~[illegible]~~ ala.)

KOH to product storage tanks: also stored

NaOH, K_2CO_3, KOH

barged in for storage

Point AA

Point BB K_2CO_3 & $K(CO_3)_2$ production Process

CO_2 natural gas burned in boilers

combined w/ KOH to produce K_2CO_3 $KH(CO_3)_2$

Bagged ~~+~~ stored. ~~[illegible]~~

Point CC = maintenance shops

Point DD electrical substation area.

Old transformers located along eastern wall of DD. (DD')

In operation '54-85

Old transformers

Possibly Oil switching stations had PCB's also.

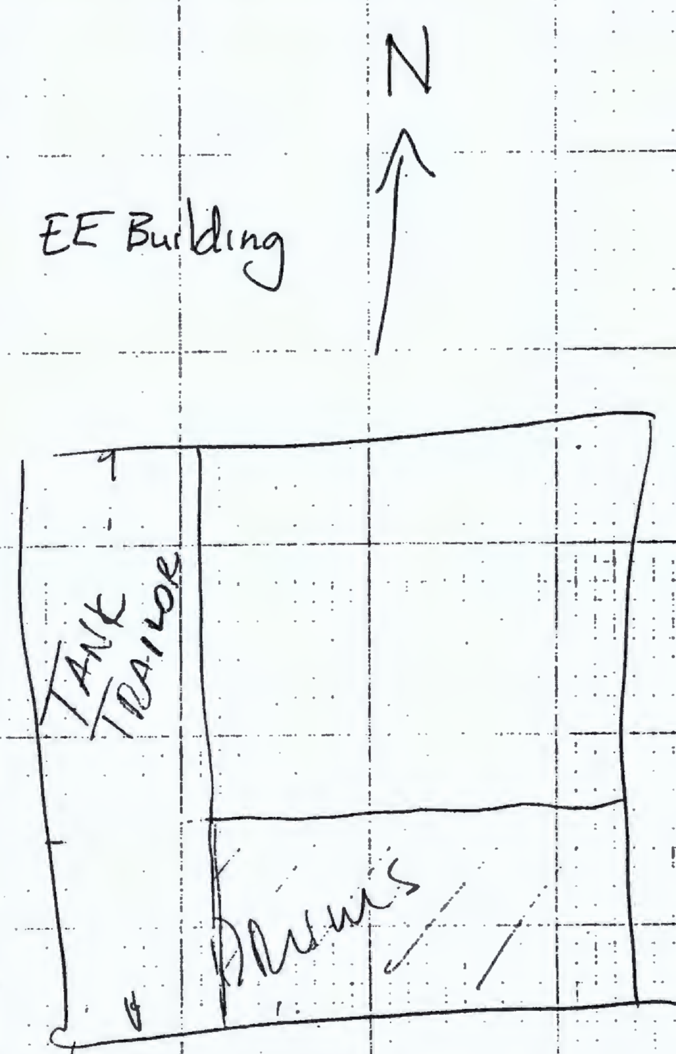
PCB handling

PCB storage building
used for PCB wastes
(spills, contaminated materials)
EE → in South + east
~~Be~~ sides of insulation
materials building

incorrect

PCB waste inventory
+ clean ups subject to
inspection + record-keeping

PCB storage start-up 82-83



Solvent storage building
FF

GG Lab sewer system
piped to WWTP
(

HH storage warehouses –
mercury storage at HH

II 1st aid / security

JJ administration

KK Worker Change House

LL Engineering Prod.

MM Paint Shop

NN Water cooling tower &
sandblasting

<u>Stressed Vegetation Area</u>

Excess brine was periodically
purged to stressed veg.
area S. of impoundment
basin. Was necessitated
prior to switching from
carbon anode to dimensionally
in 1970-71 stabilized anode;

Entire 'low area' (wooded
area S of facility wooded
as late as 1963.

Reported use of hoses to
run brine downgradient
from either sludge pad basins
or product towers.

- Noted that geophysical survey did not extend beyond stressed vegetation area
- also noted for SW corner of N. impoundment basin

Point OO Truck + rail product loading

Wastepile A – Point PP currently a parking lot.

GW monitor closure plan submitted to state.

→ Staging area for waste haul-off. Primarily drums.

Pre-1982 PCB storage and disposal is unknown.

all UST's removed prior to fed UST reg. deadlines

2:05 p.m

Initiated Site Tour

Weather, Overcast ~60°F

R1P9 – former

PCB storage area

solid slab floor, no drains, building used for insulation materials storage

R1P10

PCB storage area former trailer section

R1P11

.5·10⁶ wastewater storage tank

R1 P12
Former KCl
sludge pad

R1 P13
Outfall (stormwater)
~~upgradient~~leading ~~to~~ of stressed
vegetation area

R1 P14 f-S
stressed vegetation area

panorama shot

R1 P15 f-SW
same

R1 P16
same

R1 P17 f west
former hypalon tank area

R1 P18 f east from
same location - south
impoundment basin area

R1 P19. f-north
S impoundment basin
surface w/ KCl
tank cars in bckgrd.

R1 P20, 21, 22
f E S. impoundment

R1 P23
f W at northwest
corner of S impoundment

R1 P23
Close up S imp surface

R1 P24
F E former
11 KCl salt storage pile
area

R1 P25
F E former
12 NaCl storage pile area

R1 P26, 27
Manhole for sewer outfall
pipe

R1 P28 shot into
manhole

R1 P29 F W
into sewer outfall

R1 P30 F S
18 down plant outfall ditch
at headwaters next to
sewer outfall

R1 P31 F N
19 same

R1 P32
Emergency Cl^- scrubbers

R1 P33
Hypo - decomposition tank
holds spent scrubber
solution

R1 P34
spent scrubber Tank as
above

R1 P 35 bleach odor detected
outfall draining
spent scrubber tank

R2 P1 f ~~E~~ N
same outfall as
above

R2 P2 Cooling water
outfall at immediate
SE corner w/ stormwater
runoff ~~to~~ bed to right
of pipe

R2 P3 F N
drainage at RR
crossing NE of
emergency scrubbers'
N along plat outfall
ditch

R2 P4 f ~ S
at NW corner of landfill
point of discharge - all
stormwater + industrial
sewer

R2 P5-8 panorama
across landfill

R2 P9 subsidence of
asphalt perimeter ditch
~ 100 yards SE of
R2 P4 location

R2 P10 same location
across landfill

R2 P11 same + (left off Photo Pages)

R2 P12 landfill boundary
Base of NE corner at PVC limit

R2 P13
F. away from facility atop landfill

R2 P14
F. Towards facility & pipeline

R2 P15
F ~~[illegible]~~ landfill
w/ [illegible] activity

R2 P16
landfill surface w/ bare area

R2 P17
F N bare areas immediately N of landfill

R2 P18
N basin area w/ well cluster

R2 P19 - 25
panorama starting from N.

R2 P26
landfill surface
fire ant mound

R2 P27 Borrow site
adjacent to ~~landfill~~
taken at landfill gate

~~R2 P28~~
R3 P1 ~~Old~~ transformers
(PA not old)

R3 P2 two wells
located adjacent to industrial sewer
OW 46 + 47

R3 P3 HCl unloading area
P3 P4 rainwater/acid spill containment basin

R3 P5 f towards mercury cell
room

R3 P6 surface of gravel
area adjacent to former
demo cell w/ oily smelling
soil surface below gravel

R3 P7 Waste Pile Area A
~ 60 yards from
water tower

R3 P8 "Upper Pond
Creek Outfall" w/ flow
meter Industrial Sewer Line
27 outfall

R3 P9
Final outfall treatment
area adjacent to
Wilson Dam Road

R3 P10-13
Panorama of
N impoundment basin

R3 P14
Outfall facing
Wilson Dam Road

12/13/91 Day 2 VSI
7:45 a.m. meeting

In attendance:

Gerald Clarke Andy Langert Chris	OxyChem
Pat Anderson	EPA IV
Ron Adams	G+E Engineering
Ayman El-Husseini	State of Alabama
David Anderson Brian Sullivan	KWBES

Discussion of days tour activities,
Mr. Adams indicated post-cap construction photos available for 2nd cap construction.

12/13/91

Continuation of facility tour.

Weather: Rain, ~60°F

~~Mercury~~ Cell Room

R3 P15, 16
Cell room [illegible]

15 amp picture came out OK

~~R3~~ P17 ~~[illegible]~~ active trench
~~S~~ side of MCR

3 Pictures didn't come out

~~R3 P18~~ [illegible]
F W from N half of
~~M~~CR w/ wash-down
& [illegible]

R3 P19
Close-up ~~of cell~~

R3 P20
Same as above after
wash down

R3 P21

Decompose tanks, facility
has 116, strip mercury
from K by carbon
filtration

R3 P22 H_2SO_4 acid tanks

R 23 Adams filter

R3 4 P1 Retort
tanks

R 4 P 1 Retort tanks
P 2 Collection Vessel
~~3~~ daily mercury recovery; Hg
~~piped~~ collected & recycled to cell room

Retort tanks on W side of MCR near mid-point of bldg.
P3 Water purge to Int. sewer drain

R4 P~~4~~ Saturator tank
P5 "
P6 "
P7 "
P8 Back-flush from Clarifier
P8 filter
P9 Material collected from filters

R4 P10 Rack of filters
R4 P11 Sump from Clarifier
R4 P12 " " "
R4 P13 Clarifier
R4 P14 ~~Clarifier~~ "
R4 P15 Carbon filters
R4 P16 unidentified tank
R4 P17-18 KOH Process area
R4 P18 Waste Storage area
R4 P19 Sludge Pad
R4 P20 South impoundment Basin (former)
R4 P21 unidentified Pipe w/ Salt deposits

R4 P22-33 Landfill site after precipitation event

R5-P1-16 area of stressed vegetation South of Plant site

R6 P1-~~10~~8 areas of ~~[illegible]~~ gravel cover around Plant Site

R6 P9-11 Junk Yard

R6 P12 look at former N. Imp Basin from Pipeline

RG P13-14 apparent
borrow site with some
construction debris located
north of junk yard

R G P15 off TVA pipeline
right of-way

R6 P16 Storage area
NW of plant site

APPENDIX B

PHOTOGRAPHIC LOG

1.1 Close-up of the asphalt lined perimeter ditch that extends along the southwestern side of the Landfill (SWMU 1).

1.2 View of the Landfill (SWMU 1) from the south side of the perimeter ditch.

1.3 Area along the northeastern side of the Landfill (SWMU 1) with the PVC pipes that mark the edge of the geomembrane.

1.4 Area of good vegetative cover on the Landfill (SWMU 1).

1.5 Bare areas on the Landfill (SWMU 1) cover.

1.6 Additional bare areas on the Landfill (SWMU 1) cover.

1.7 Hole in the cover of the Landfill (SWMU 1) created by animal activity.

1.8 An ant hill on the cover of the Landfill (SWMU 1).

1.9 One of four photographs in a panoramic view to the northwest of the area northeast of the Landfill (SWMU 1) (northeast view).

1.10 One of four photographs in a panoramic view to the northwest of the area northeast of the Landfill (SWMU 1) (north view).

1.11 One of four photographs in a panoramic view to the northwest of the area northeast of the Landfill (SWMU 1) (north-northwest view).

1.12 One of four photographs in a panoramic view to the northwest of the area northeast of the Landfill (SWMU 1) (northwest view).

1.13 Area of standing water on the Landfill (SWMU 1) following a precipitation event (looking east toward the Landfill (SWMU 1) gate).

1.14 Area of standing water on the Landfill (SWMU 1) following a precipitation event (looking north across the Landfill).

1.15 Area of standing water on the Landfill (SWMU 1) following a precipitation event (looking northwest across the Landfill).

2.1 Looking east across the Former South Impounding Basin (SWMU 2).

2.2 Looking north across the Former South Impounding Basin (SWMU 2).

2.3 Bare areas on the backfilled surface of the Former South Impounding Basin (SWMU 2).

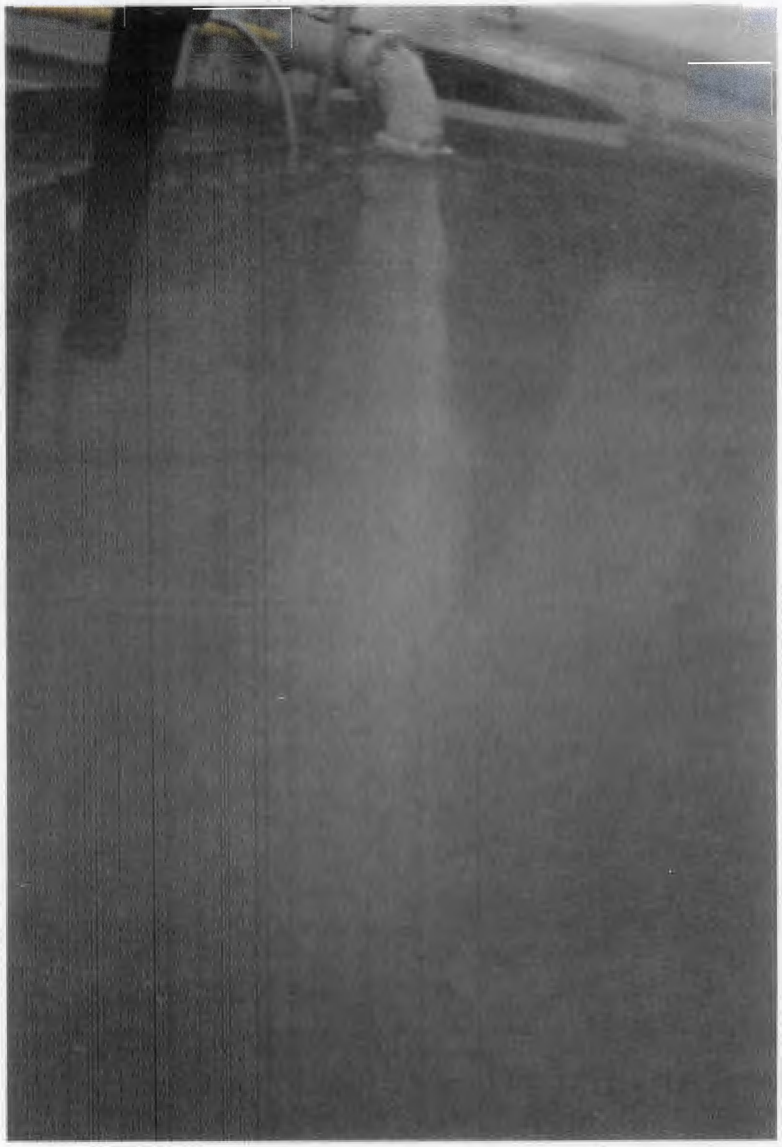
2.4 Close-up of a bare spot on the backfilled surface of the Former South Impounding Basin (SWMU 2).

3.1 Looking north across the western end of the Former North Impounding Basin (SWMU 2).

3.2 Looking west from the pipeline crossing the central portion of the Former North Impounding Basin (SWMU 3).

4.1 Former KCl Salt Storage Piles.

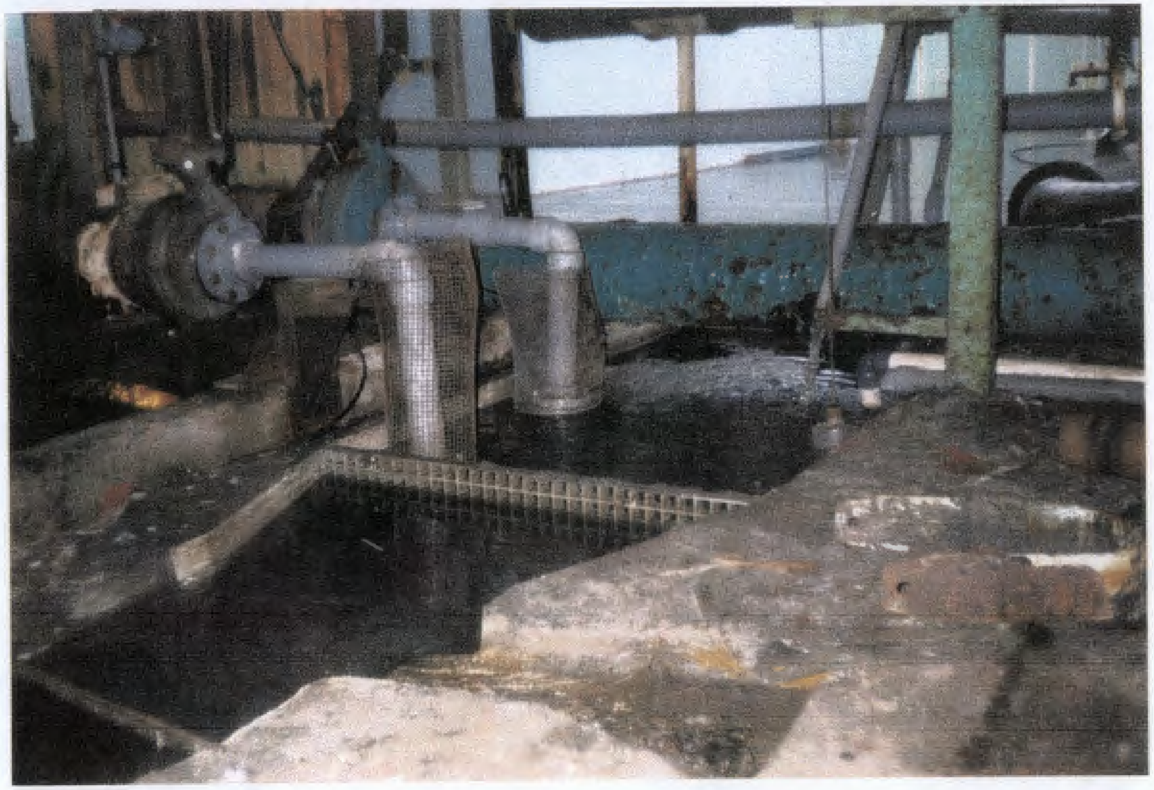
4.2 Former NaCl Salt Storage Piles.



5.1 Closed up of the Brine Filter Backwash Collection Tank (SWMU 5).

6.1 Overview of the KCl Sludge Pad.

6.2 Overview of the NaCl Sludge Pad.



7.1 Sump to the Mercury Cell Room Trench System (SWMU 7).

8.1 Previous location of the Hypalon-Lined Storage Tank (SWMU 8).

9.1 View of the Mercury Retort Tanks (SWMU 9) .

10.1 Overview of the Mercury Separation Vessel with stains on concrete surrounding Mercury Collection Vessel (SWMU 10).

10.2 Close-up of stains on concrete indicating the mercury wastewater path to stormwater sewer system.

11.1 Overview of the Hazardous Waste Roll-Off Pad (SWMU 11).

12.1 View of the Emergency Chlorine Scrubber Tanks (SWMU 12).

13.1 Overview of the Scrubber Solution Treatment Tanks (SWMU 13).

13.2 Close-up of the Scrubber Solution Treatment Tanks (SWMU 13).

14.1 Manhole cover (located 200 feet southeast of the southeast corner of the electricity substation) leading to the Industrial Sewer System (SWMU 14).

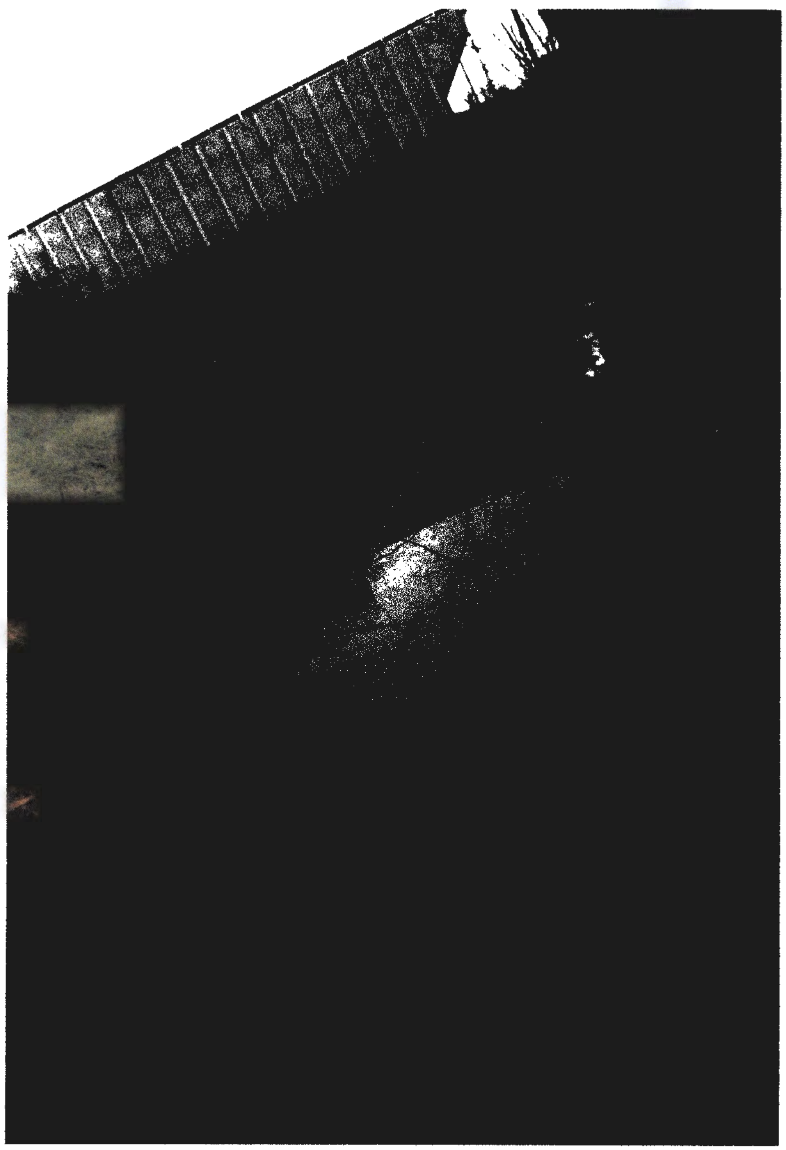
14.2 View under manhole cover located 200 feet southeast of the southeast corner of the electricity substation.

14.3 Outfall (for the sewer shown in Photograph 14.2 and located approximately 100 feet east of the manhole cover shown in Photograph 14.1) which drains into the Old East Outfall Ditch (SWMU 15).

14.4 Manhole cover (located 200 feet northeast of the northeast corner of the electricity substation) leading to the Industrial Sewer System (SWMU 14).

14.5 View under manhole cover located 200 feet northeast of the northeast corner of the electricity substation.

14.6 Outfall (for the sewer shown in Photograph 14.5 and located approximately 100 feet east of the manhole cover shown in Photograph 14.4) which drains into the Old East Outfall Ditch (SWMU 15) approximately 400 feet north of the outfall depicted in Photograph 14.3.

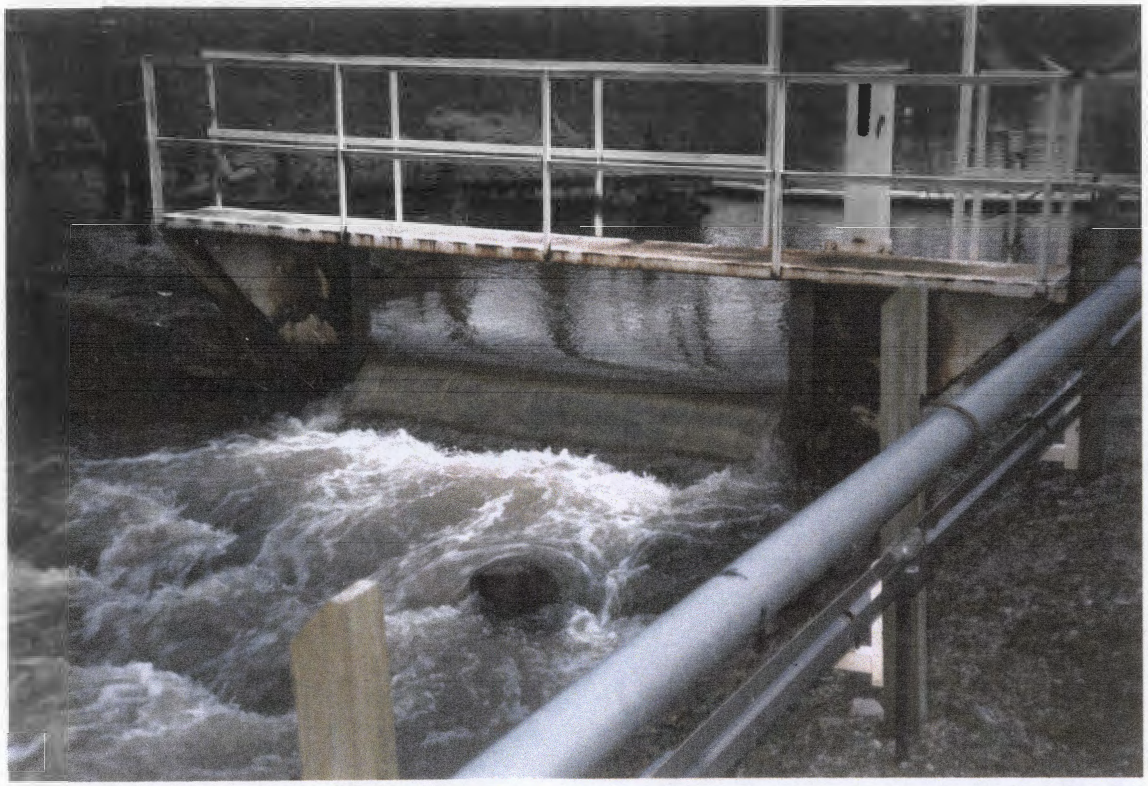


15.1 Looking south along the Old East Outfall Ditch (SWMU 15) from the point where the outfall depicted in Photograph 14.3 enters the ditch.

15.2 Looking north along the Old East Outfall Ditch (SWMU 15) from the point where the outfall depicted in Photograph 14.3 enters the ditch.

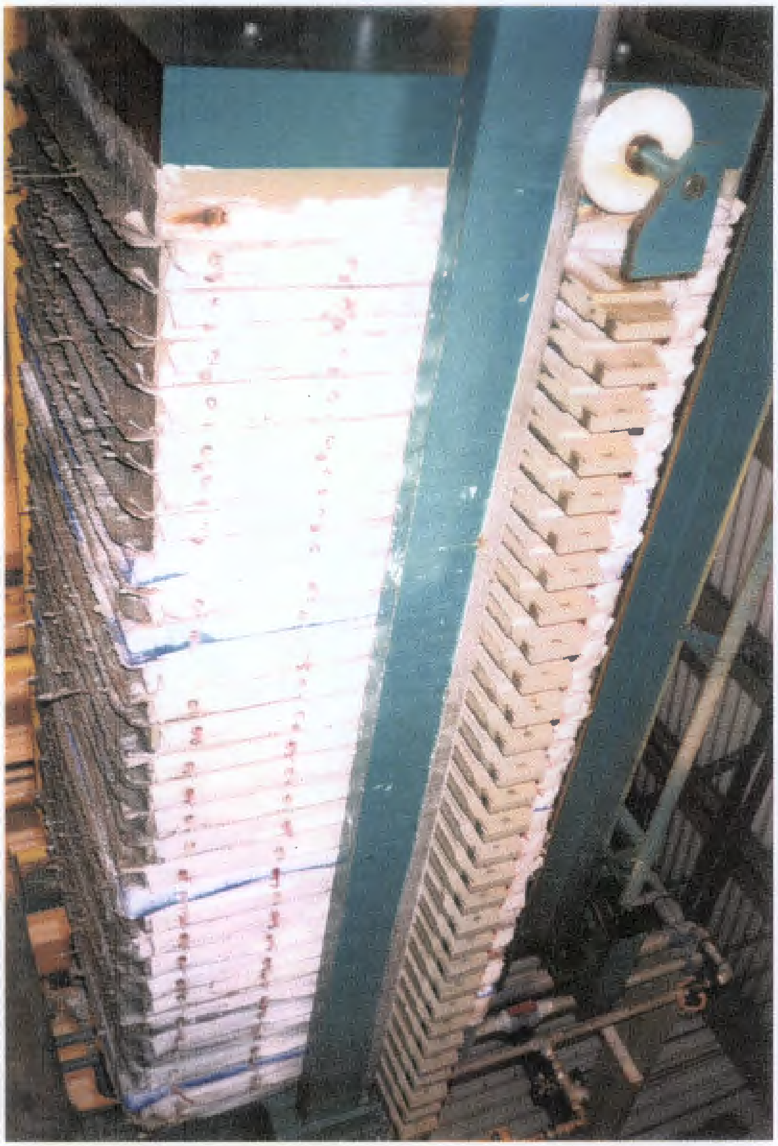
15.3 Further north than in Photograph 15.2 along the Old East Outfall Ditch (SWMU 15) (from the point where the outfall depicted in Photograph 14.3 enters the ditch.

15.4 Point where the Old East Outfall Ditch enters the NPDES Outfall Ditch (SWMU 16).



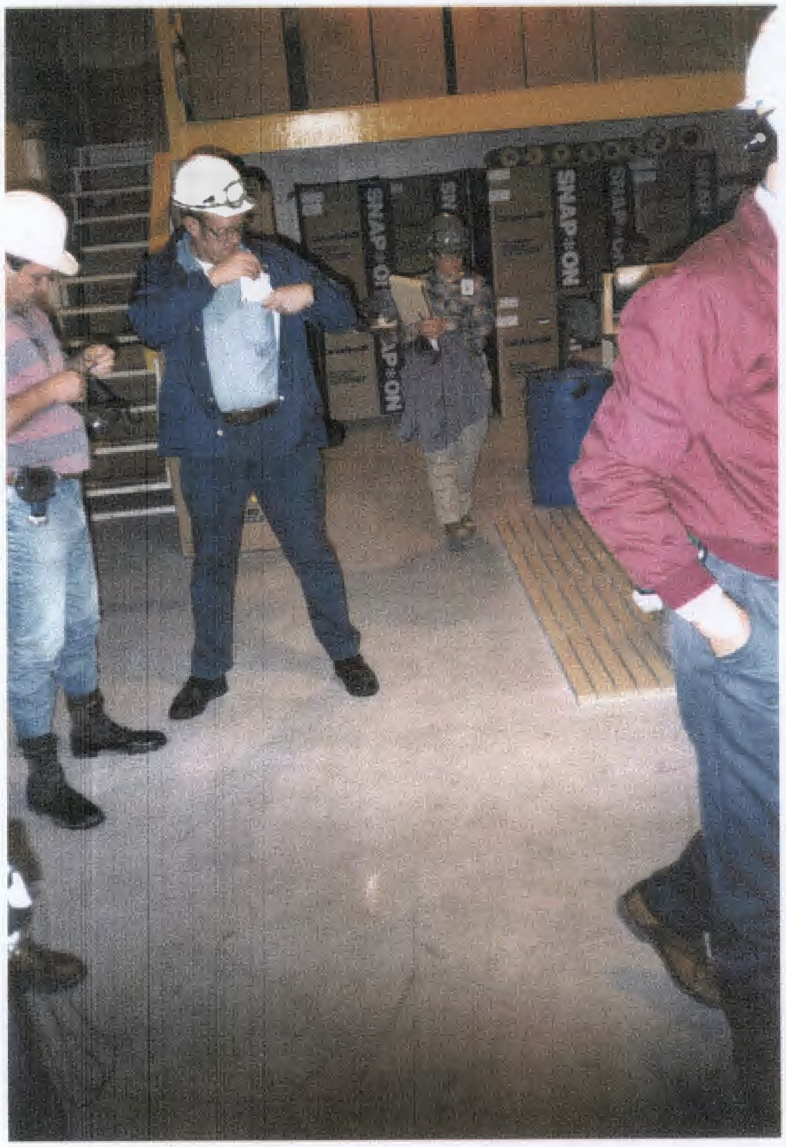
16.1 NPDES Outfall Ditch (SWMU 16).

16.2 NPDES outfall at the end of the NPDES Outfall Ditch (SWMU 16).



17.1 Wastewater Treatment Frame Filter Presses (SWMU 17).

17.2 View into the Hopper for solids from the Wastewater Treatment Frame Filter Presses (SWMU 17).



18.1 View of the Former PCB Storage Area (SWMU 18).

19.1 View of the 500,000-Gallon Wastewater Storage Tank (SWMU 19).

23.1 Stormwater outfall directly southwest of the Former South Impounding Basin (SWMU 2) and draining into the Stressed Vegetation Area (SWMU 24).

24.1 Stressed Vegetation Area (SWMU 24) south of the plant fence and southwest of the Former South Impounding Basin (SWMU 2).

24.2 Close-up view looking southeast across the Stressed Vegetation Area (SWMU 24) south of the plant fence and southwest of the Former South Impounding Basin (SWMU 2).

24.3 Close-up view looking south across the Stressed Vegetation Area (**SWMU** 24) south of the plant fence and southwest of the Former South Impounding Basin (SWMU 2).

A.1 Looking east across the Junkyard (AOC A).

A.2 Looking southeast across the Junkyard (AOC A).

A.3 Runoff exiting the western end of the Junkyard (AOC A).

B.1 Old TVA Pipeline Right-of-Way.

C.1 Stains on gravel in an area 20 feet south of the electric substation and 200 feet northwest of the manhole cover in Photograph 14.1.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

AUG 16 2001

MEMORANDUM

SUBJECT: Technical Review Request
RFI Report
Occidental Chemical Corporation, Muscle Shoals, AL
EPA I. D. Number ALD 004 019 642

FROM: Russ McLean
South Programs Section
RCRA Programs Branch

RLM 8/14/01

THRU: Doug McCurry, Chief
South Programs Section
RCRA Programs Branch

DM 8/16/01

TO: Elmer Akin, Chief
Office of Technical Services

The RCRA Programs Branch, South Programs Section, and the Alabama Department of Environmental Management (ADEM) are requesting technical assistance in the review of the human health and ecological risk assessment portion of the above-referenced report. Section 3.12, Offsite Area- Pond Creek, pages 23 through 28, details the sampling results and environmental setting of Pond Creek. Appendix B presents an "Interpretation of Potential Ecological and Human Health Risks Due to PCBs and Mercury in Pond-Creek Sediments".

Please review these portions of the Report and provide comments by September 14, 2001. Additional information regarding the facility is available upon request. Should you have any questions or require any additional information, please contact me at vmx 2-8504 or Metz Duites of ADEM at (334) 271-7754.

Attachment